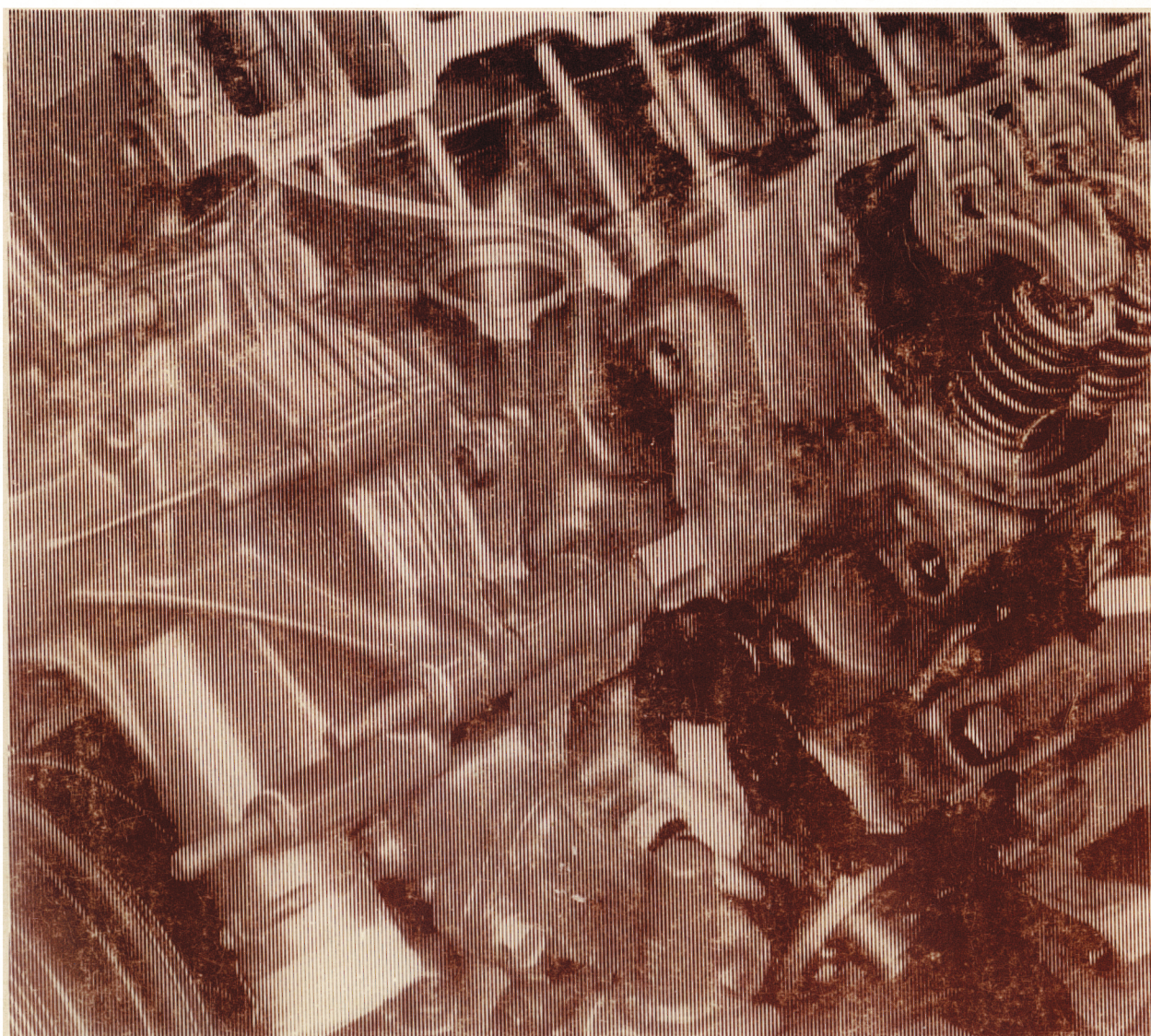


LIGHT

TRUCK ENGINE SHOP MANUAL

BRONCO, ECONOLINE (E-100 THROUGH E-350),
AND F-100 THROUGH F-350

1980



GROUP AND PART INDEX

GROUP TITLE	PART TITLE	PAGE	GROUP TAB LOCATOR
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GASOLINE ENGINES GROUP 21 (6000 & 9000)	GASOLINE ENGINES — General Service	21-01-1	
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	— 5.0L (302 CID) V-8 and 5.8L (351 CID) W-V-8	21-21-1	
	— 5.8L (351 CID) M-V-8 and 6.6L (400 CID) V-8	21-22-1	
	— 7.5L (460 CID) V-8 Engine	21-24-1	
IDENTIFICATION CODES GROUP 20	IDENTIFICATION CODES	20-00-1	
IGNITION SYSTEM GROUP 23 (12000)	GENERAL IGNITION SERVICE	23-01-1	
INDEX	ALPHABETICAL INDEX OF MAJOR TITLES		
METRICS	METRIC FASTENER INFORMATION AND CONVERSION CHARTS		
STARTING SYSTEM GROUP 28 (11000)	STARTING SYSTEM GENERAL SERVICE	28-01-1	
	STARTER — Positive Engagement	28-02-1	

IMPORTANT SAFETY NOTICE

Appropriate service methods and proper repair procedures are essential for the safe, reliable operation of all motor vehicles as well as the personal safety of the individual doing the work. This Shop Manual provides general directions for accomplishing service and repair work with tested, effective techniques. Following them will help assure reliability.

There are numerous variations in procedures, techniques, tools, and parts for servicing vehicles, as well as in the skill of the individual doing the work. This Manual cannot possibly anticipate all such variations and provide advice or cautions as to each. Accordingly, anyone who departs from the instructions provided in this Manual must first establish that he compromises neither his personal safety nor the vehicle integrity by his choice of methods, tools or parts.

NOTES, CAUTIONS, AND WARNINGS

As you read through the procedures, you will come across NOTES, CAUTIONS, and WARNINGS. Each one is there for a specific purpose. NOTES give you added information that will help you to complete a particular procedure. CAUTIONS are given to prevent you from making an error that could damage the vehicle. WARNINGS remind you to be especially careful in those areas where carelessness can cause personal injury. The following list contains some general WARNINGS that you should follow when you work on a vehicle.

- Always wear safety glasses for eye protection.
- Use safety stands whenever a procedure requires you to be under the vehicle.
- Be sure that the ignition switch is always in the OFF position, unless otherwise required by the procedure.
- Set the parking brake when working on the vehicle. If you have an automatic transmission, set it in PARK. If you have a manual transmission, it should be in REVERSE.
- Operate the engine only in a well-ventilated area to avoid the danger of carbon monoxide.
- Keep yourself and your clothing away from moving parts, when the engine is running, especially the fan and belts.
- To prevent serious burns, avoid contact with hot metal parts such as the radiator, exhaust manifold, tail pipe, catalytic converter and muffler.
- Do not smoke while working on the vehicle.
- To avoid injury, always remove rings, watches, loose hanging jewelry, and loose clothing before beginning to work on a vehicle.

foreword . . .

This 1980 Truck Shop Manual has been prepared to provide information covering normal Engine and related systems service repairs and maintenance for the 1980 Bronco, Econoline (E-100 through E-350), and F-100 through F-350 Series Ford Trucks manufactured in the United States and Canada.

Electrical, Pre-Delivery, Maintenance and Lubrication service repairs are covered in the 1980 Light Truck, Body, Chassis and Electrical Shop Manual and the 1980 Truck Pre-Delivery, Maintenance and Lubrication Manual.

This manual is divided into Groups covering a general system. The basic part number for components covered in the Group is also included in parenthesis after the Group number. For example:

<u>Cooling System</u> General System Covered in Group	<u>Group 27</u> Group Number	<u>(8000)</u> Basic Part Number for Cooling System Components
---	---------------------------------	--

Some components covered within a Group do not have the same basic part number. In these cases, more than one basic part number will appear on the Group index. For example:

<u>Gasoline Engines</u> General System Covered in Group	Group 21	<u>(6000)</u> Basic Part Number for Gasoline Engine Components	&	<u>9000)</u> Intake and Exhaust Manifold Basic Part Number Only
---	----------	---	---	---

Within each Group, the information is further divided into smaller sections or Parts. There is one Part for each component in the system, as well as a General Service Part in some Groups to cover procedures common to several Parts within the Group. In general, each Part contains the Description, Operation, Diagnosis and Testing, Removal and Installation and Disassembly and Assembly procedures for the component covered in the Part. Diagnosis Charts are also included in some Parts to help you systematically locate and correct problems encountered. In most cases, specifications are included at the end of each Part.

To aid in locating specific items in this manual, use the Alphabetical Subject Index in the back of the manual, or the Group and Part Index on the following pages. The tab locator on the right side of this Group and Part Index will help you find the first page of each Group.

As a further aid, there is an index on the first page of each Group listing the Part title and Part number for each component covered within the Group. The first page of each Part contains an index to locate service operations covered in that Part. This Group-Part breakdown is also indicated in the page number located at the top of each page.

Example: 21-01-10 = (Group) 21 — (Part) 01 — (Page) 10

The descriptions and specifications in this manual were in effect at the time this manual was approved for printing. Ford Motor Company reserves the right to discontinue models at any time, or change specifications or design without notice and without incurring obligation.



Ford Parts and Service Division
Training and Publications Department

METRICS

SUBJECT	PAGE	SUBJECT	PAGE
Decimal/Metric Equivalents		Strength Identification	
Chart	5	Bolts	2
English/Metric Conversion		Hex Nuts	3
Chart	4	Studs	3
Introduction	1	Tapping Screws	3
Nomenclature for Bolts	2	Thread Forming Screws	3
		U-Nuts	3
		Torque Conversion Chart	6

INTRODUCTION

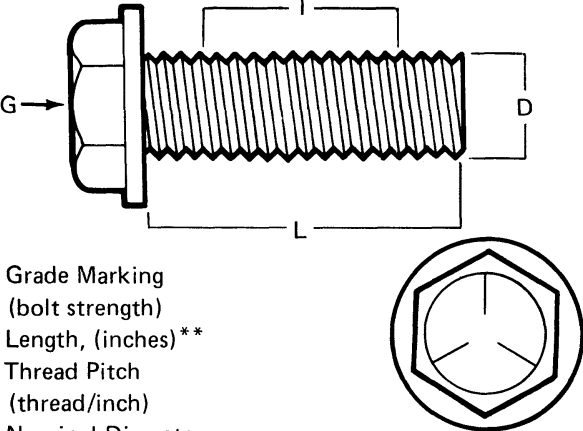
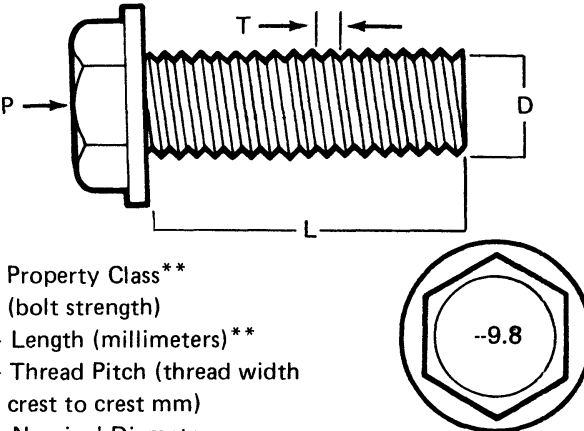
Most threaded fasteners are covered by specifications that define required mechanical properties, such as tensile strength, yield strength, proof load and hardness. These specifications are carefully considered in initial selection of fasteners for a given application. To assure continued satisfactory vehicle performance, replacement fasteners used should be of the correct strength, as well as the correct nominal diameter, thread pitch, length, and finish.

Most original equipment fasteners (English system or metric) are identified with markings or numbers indicating the strength of the fastener. These markings are described in the pages that follow. Attention to these markings is important in assuring that the proper replacement fasteners are used.

Further, some metric fasteners, especially nuts, are colored blue. This metric blue identification is in most cases a temporary aid for production start-up, and color will generally revert to normal black or bright after start-up.

English system and metric system fasteners are available through your Ford Parts and Service operation.

NOMENCLATURE FOR BOLTS

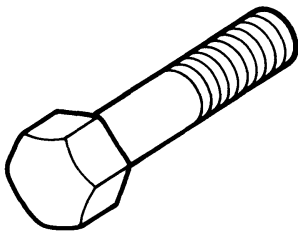
(ENGLISH) INCH SYSTEM Bolt, 1/2-13x1	METRIC SYSTEM Bolt M12-1.75x25
 G- Grade Marking (bolt strength) L- Length, (inches)** T- Thread Pitch (thread/inch) D- Nominal Diameter (inches)	 P- Property Class** (bolt strength) L- Length (millimeters)** T- Thread Pitch (thread width crest to crest mm) D- Nominal Diameter (millimeters)

*The property class is an Arabic numeral distinguishable from the slash SAE English grade system.

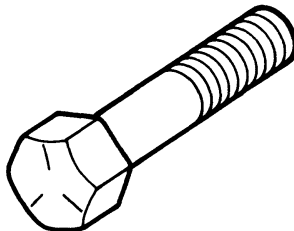
**The length of all bolts is measured from the underside of the head to the end.

BOLT STRENGTH IDENTIFICATION

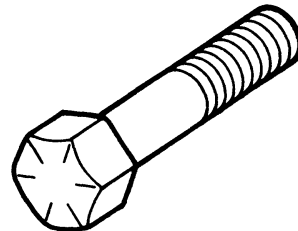
(ENGLISH) INCH SYSTEM



Grade 1 or 2



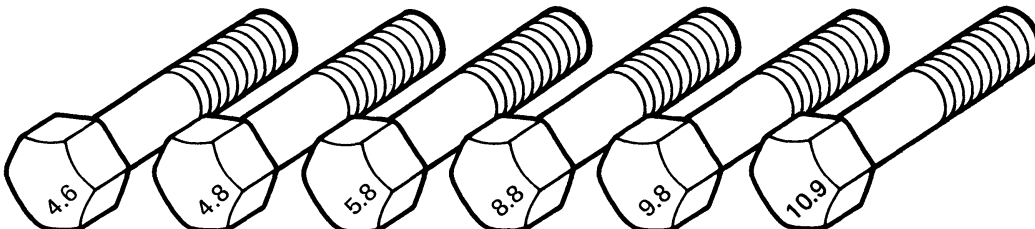
Grade 5



Grade 8

(English) Inch bolts - Identification marks correspond to bolt strength - increasing number of slashes represent increasing strength.

METRIC SYSTEM



Metric bolts - Identification class numbers correspond to bolt strength - increasing numbers represent increasing strength. Common metric fastener bolt strength property are 9.8 and 10.9 with the class identification embossed on the bolt head.

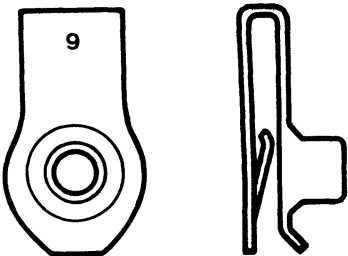
HEX NUT STRENGTH IDENTIFICATION

(ENGLISH) INCH SYSTEM		METRIC SYSTEM	
Grade	Identification	Class	Identification
Hex Nut Grade 5	 3 Dots	Hex Nut Property Class 9	 Arabic 9
Hex Nut Grade 8	 6 Dots	Hex Nut Property Class 10	 Arabic 10
Increasing dots represent increasing strength.		May also have blue finish or paint daub on hex flat. Increasing numbers represent increasing strength.	

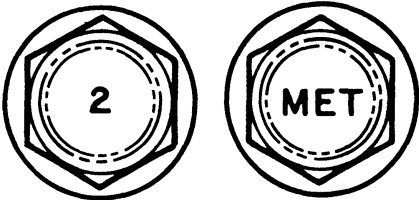
OTHER TYPES OF PARTS

Metric identification schemes vary by type of part, most often a variation of that used of bolts and nuts. Note that many types of English and metric fasteners carry no special identification if they are otherwise unique.

–Stamped “U” Nuts



–Tapping, thread forming and certain other case hardened screws



–Studs, Large studs may carry the property class number. Smaller studs use a geometric code on the end.



CLASS
10.9



CLASS
9.8



CLASS
8.8

DECIMAL AND METRIC EQUIVALENTS

Fractions	Decimal In.	Metric mm.	Fractions	Decimal In.	Metric mm.
1/64	.015625	.397	33/64	.515625	13.097
1/32	.03125	.794	17/32	.53125	13.494
3/64	.046875	1.191	35/64	.546875	13.891
1/16	.0625	1.588	9/16	.5625	14.288
5/64	.078125	1.984	36/64	.578125	14.684
3/32	.09375	2.381	19/32	.59375	15.081
7/64	.109375	2.778	39/64	.609375	15.478
1/8	.125	3.175	5/8	.625	15.875
9/64	.140625	3.572	41/64	.640625	16.272
5/32	.15625	3.969	21/32	.65625	16.669
11/64	.171875	4.366	43/64	.671875	17.066
3/16	.1875	4.763	11/16	.6875	17.463
13/64	.203125	5.159	45/64	.703125	17.859
7/32	.21875	5.556	23/32	.71875	18.256
15/64	.234375	5.953	47/64	.734375	18.653
1/4	.250	6.35	3/4	.750	19.05
17/64	.265625	6.747	49/64	.765625	19.447
9/32	.28125	7.144	25/32	.78125	19.844
19/64	.296875	7.54	51/64	.796875	20.241
5/16	.3125	7.938	13/16	.8125	20.638
21/64	.328125	8.334	53/64	.828125	21.034
11/32	.34375	8.731	27/32	.84375	21.431
23/64	.359375	9.128	55/64	.859375	21.828
3/8	.375	9.525	7/8	.875	22.225
25/64	.390625	9.922	57/64	.890625	22.622
13/32	.40625	10.319	29/32	.90625	23.019
27/64	.421875	10.716	59/64	.921875	23.416
7/16	.4375	11.113	15/16	.9375	23.813
29/64	.453125	11.509	61/64	.953125	24.209
15/32	.46875	11.906	31/32	.96875	24.606
31/64	.484375	12.303	63/64	.984375	25.003
1/2	.500	12.7	1	1.00	25.4

ENGLISH METRIC CONVERSION

	multiply	by	for equiv. no. of:
ACCELERATION	Foot/sec ² Inch/sec ²	0.304 8 0.025 4	meter/sec ² (m/s ²) meter/sec ²
TORQUE	Pound-inch Pound-foot	0.112 98 1.355 8	newton-meters (N·m) newton-meters
POWER	horsepower	0.746	kilowatts (kw)
PRESSURE or STRESS	inches of water pounds/sq. in.	0.249 1 6.895	kilopascals (kPa) kilopascals (kPa)
ENERGY or WORK	BTU foot-pound kilowatt-hour	1 055. 1.355 8 3 600 000. or 3.6 x 10 ⁶	joules (J) joules (J) joules (J=one W's)
LIGHT	foot candle	10.76	lumens/meter ² (lm/m ²)
FUEL PERFORMANCE	miles/gal gal/mile	0.425 1 2.352 7	kilometers/liter (km/l) liters/kilometer (l/km)
VELOCITY	miles/hour	1.609 3	kilometer/hr. (km/h)
LENGTH	inch foot yard mile	25.4 0.304 8 0.914 4 1.609	millimeters (mm) meters (m) meters kilometers (km)
AREA	inch ² foot ² yard ²	645.2 6.45 0.092 9 0.836 1	millimeters ² (mm ²) centimeters ² (cm ²) meters ² (m ²) meters ²
VOLUME	inch ³ quart quart gallon yard ³	16 387. 16.387 0.016 4 0.946 4 3.785 4 0.764 6	mm ³ cm ³ liters(1) liters liters meters ³ (m ³)
MASS	pound ton ton	0.453 6 907.18 0.907	kilograms (kg) kilograms (kg) tonne (t)
FORCE	kilogram ounce pound	9.807 0.278 0 4.448	newtons (N) newtons newtons
TEMPERATURE	degree fahrenheit	(1°F 32) 1.8	degree Celsius

TORQUE CONVERSION

NEWTON METERS (N·m)	POUND-FEET (LB.-FT.)
1	0.7376
2	1.5
3	2.2
4	3.0
5	3.7
6	4.4
7	5.2
8	5.9
9	6.6
10	7.4
15	11.1
20	14.8
25	18.4
30	22.1
35	25.8
40	29.5
50	36.9
60	44.3
70	51.6
80	59.0
90	66.4
100	73.8
110	81.1
120	88.5
130	95.9
140	103.3
150	110.6
160	118.0
170	125.4
180	132.8
190	140.1
200	147.5
225	166.0
250	184.4

POUND-FEET (LB.-FT.)	NEWTON METERS (N·m)
1	1.356
2	2.7
3	4.0
4	5.4
5	6.8
6	8.1
7	9.5
8	10.8
9	12.2
10	13.6
15	20.3
20	27.1
25	33.9
30	40.7
35	47.5
40	54.2
45	61.0
50	67.8
55	74.6
60	81.4
65	88.1
70	94.9
75	101.7
80	108.5
90	122.0
100	135.6
110	149.1
120	162.7
130	176.3
140	189.8
150	203.4
160	216.9
170	230.5
180	244.0

IDENTIFICATION CODES

**GROUP
20**

Identification Codes

**PART
20-00**

APPLIES TO ALL MODELS

SUBJECT	PAGE	SUBJECT	PAGE
GENERAL INFORMATION		VEHICLE DATA (Cont'd.)	
Build Date Stamp Locations	20-00-3	Exterior Paint Color Codes	20-00-4
VEHICLE CERTIFICATION LABEL	20-00-2	Max. GVW Codes	20-00-6
Vehicle Rating Decal	20-00-1	Sequential Serial and Warranty Number Codes	20-00-4
VEHICLE DATA	20-00-1	Transmission Codes	20-00-8
Assembly Plant Codes	20-00-4	Truck Series Codes	20-00-3
Axle Codes (Front)	20-00-10	Type/GVW Codes	20-00-6
Axle Codes (Rear)	20-00-9	Wheelbase Codes	20-00-5
Body Codes	20-00-4	VEHICLE IDENTIFICATION NUMBER	20-00-1
D.S.O. Codes	20-00-10		
Engine Codes	20-00-5		

GENERAL INFORMATION

SAFETY COMPLIANCE CERTIFICATION LABEL

The Safety Compliance Certification Label is attached to the driver's door lock pillar (Figs. 1 and 2). The label contains the name of the manufacturer, the month and year of manufacture, the certification statement, and the Vehicle Identification Number. The label also contains Gross Vehicle Weight Rating and Gross Axle Weight Ratings, wheel and tire data, and information codes for additional vehicle data.

VEHICLE IDENTIFICATION NUMBER (VEHICLE SERIAL AND WARRANTY)

The identification number located in the lower center area of the Safety Compliance Certification Label (Figs. 1 and 2) is the same number as the vehicle Serial and Warranty number. The first letter and two numbers indicate the truck series code. The letter following the truck series code designates the engine identification code. The letter following the engine identification code indicates the assembly plant at which the vehicle was built. The remaining letters and numbers indicate the consecutive unit number (Serial and Warranty number). The charts that follow list the various vehicle identification number codes.

NOTE: The Vehicle Identification Number will also be stamped on a metal tab that will be riveted to the instrument panel close to the windshield on the drivers side of the truck and will be visible from the outside.

VEHICLE DATA

The Vehicle Data appears on the Safety Compliance Certification Label on the second and third lines following the identification number. The code set (two numbers, or a number and letter) above COLOR identify the exterior paint color (two sets of codes designate a two-tone). The letter and three digits under TYPE/G.V.W. designate the truck model within a series and the gross vehicle weight rating. The letters and/or numeral under BODY designate the interior trim, seat and body type. The transmission installed in the vehicle is identified under TRANS by an alphabetical code. A letter and a number or two numbers under AXLE identify the rear axle ratio (when required, a letter or number is also stamped after the rear axle code to identify the front axle.

A two-digit number is stamped above D.S.O. to identify the district which ordered the vehicle. If the vehicle is built to special order (Domestic Special Order, Foreign Special Order, Limited Production Option, or

SAFETY COMPLIANCE CERTIFICATION LABELS
COMPLETE VEHICLES

(UNITED STATES)

MFD. BY FORD MOTOR CO. IN U.S.A.

DATE: 8/79GVWR: 7650 LB/3470 KG

FRONT GAWR: 3050 LBRear GAWR: 5300 LB

1383 KGWITH 2404 KGWITH

F78-15BTIRES F78-15BTIRES

15x5.5 KRIMS 15x5.5 KRIMS

AT 32 PSI COLDAT 32 PSI COLD

THIS VEHICLE CONFORMS TO ALL APPLICABLE FEDERAL MOTOR VEHICLE SAFETY
STANDARDS IN EFFECT ON THE DATE OF MANUFACTURE SHOWN ABOVE

VEHICLE IDENTIFICATION NO. F25GLGA0000

TYPE TRUCK

EXTERIOR PAINT COLORS

WB | TYPE GVW | BODY | TRANS | AXLEDSO

(CANADA)

MFD. BY FORD MOTOR CO. OF CANADA LTD.

DATE:GVWR:

FRONT GAWR:REAR GAWR:

WITH

TIRES

TIRES

RIMS

RIMS

AT PSI COLDAT PSI COLD

THIS VEHICLE CONFORMS TO ALL APPLICABLE FEDERAL MOTOR VEHICLE SAFETY
STANDARDS IN EFFECT ON THE DATE OF MANUFACTURE SHOWN ABOVE

VEH. IDENT. NO. CANADA BUILT UNITS

TYPE UTILIZE SAME TYPE DATA

AS U.S.A.

EXTERIOR PAINT COLORS

WB | TYPE GVW | BODY | TRANS | AXLEDSO

(QUEBEC)

FABR. AUX E-U PAR LA FORD MOTOR CO.

DATE:PNBV:

PNBE AVANT:PNBE ARRIERE:

AVEC

«PNEUS»

«JANTES»

A LB/PO² A FROIDA LB/PO² A FROID

CE VEHICULE EST CONFORME A TOUTES LES NORMES FEDERALES DE SECURITE
DES V.A. EN VIGUEUR A LA DATE DE FABR. INIQUEE CI-DESSUS.

N° D'IDENT.

DU VEHICULE

TYPE

FABR. PAR FORD DU CANADA LIMITEE

DATE:PNBV:

PNBE AVANT:PNBE ARRIERE:

AVEC

«PNEUS»

«JANTES»

A LB/PO² A FROIDA LB/PO² A FROID

CE VEHICULE EST CONFORME A TOUTES LES NORMES FEDERALES DE SECURITE
DES V.A. EN VIGUEUR A LA DATE DE FABR. INIQUEE CI-DESSUS.

N° D'IDENT.

DU VEHICULE

TYPE

COULEUR

4° COMM SPEC.

EMPATT. | TYPE/PSV | CARR | TRANSM. | PONT

MADE IN CANADA

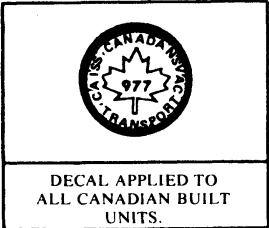
FOR VEHICLES MFD IN U.S.A. FOR QUEBEC, CANADA.

FOR VEHICLES MFD. IN CANADA FOR QUEBEC, CANADA.

INCOMPLETE VEHICLES

THE INCOMPLETE VEHICLE RATING DECAL IS INSTALLED ON THE DRIVER'S DOOR
LOCK PILLAR IN PLACE OF THE SAFETY COMPLIANCE CERTIFICATION LABEL.

VEHICLE RATING DECAL



INCOMPLETE VEHICLE MANUFACTURED BY

GVWR: 3050 LB/1383 KG

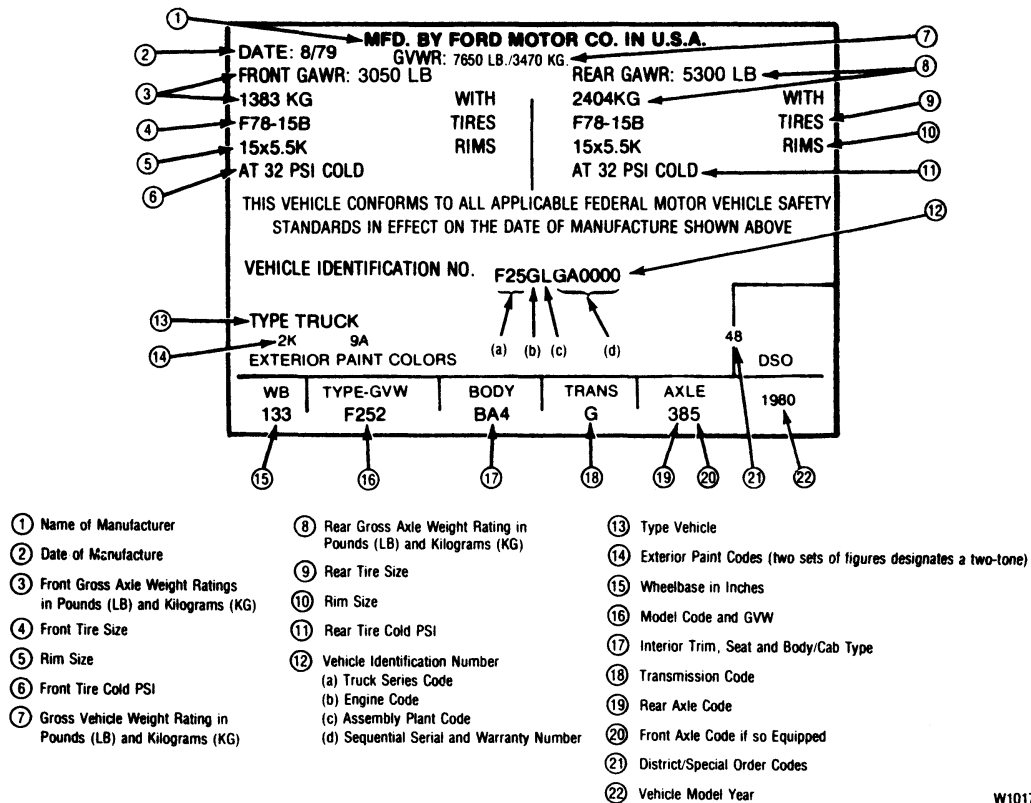
VEHICLE IDENTIFICATION NUMBER F27GLGA0001

EXTERIOR PAINT COLORS 2H48 DSO

WB | TYPE-GVW | BODY | TRANS | AXLE

133 F270 AB4 G 38 1980

FIG. 1 Typical Truck Vehicle Certification Labels



W1017-2N

FIG. 2 Typical Truck Safety Compliance Certification Label

other special order), the complete order number will also appear above D.S.O. The vehicle model year appears in the lower right corner area of the label under D.S.O. The charts that follow Fig. 2 list the various vehicle data codes.

BUILD DATE STAMP LOCATIONS

The vehicle build date stamp is located as follows: On Bronco and Light Trucks (F-100 through F-350) the vehicle build date is stamped on the front surface of the radiator support on the passengers side of the vehicle. On Econoline vehicles (E-100 through E-350), the build

date is stamped on top of the radiator support. Following is a sample of the four digit number that indicates the month and day of build.

ACTUAL DATE OF BUILD

DATE STAMP ON VEHICLE

January 24 0124

October 21 1021

Yellow ink is used for the date stamp. When the marking surface is painted the body color, the date stamp will be marked in red ink. Units from the Ontario Truck Plant (Code C) will be marked with silver ink.

TRUCK SERIES, ASSEMBLY PLANT AND SEQUENTIAL SERIAL AND WARRANTY NUMBER CODES

TRUCK SERIES CODES

BRONCO		
<u>Code</u>	<u>Description</u>	
U15	U-150 (Wagon) 4x4	

E-100 THRU E-350		
<u>Conventional Code</u>	<u>Super Code</u>	<u>Description</u>
E-100 Series		
E01	—	E100 Club Wagon
E04	—	E100 Cargo Van
E05	—	E100 Window Van
E06	—	E100 Display Van
E-150 Series		
E11	S11	E150 Club Wagon
E14	S14	E150 Cargo Van
E15	S15	E150 Window Van
E16	S16	E150 Display Van

E-100 THRU E-350 (Continued)		
<u>Conventional Code</u>	<u>Super Code</u>	<u>Description</u>
E-250 Series		
E21	S21	E250 Club Wagon
E24	S24	E250 Cargo Van
E25	S25	E250 Window Van
E26	S26	E250 Display Van
E-350 Series		
E31	S31	E350 Club Wagon
E34	S34	E350 Cargo Van
E35	S35	E350 Window Van
E36	S36	E350 Display Van
RV "Cutaway" and Chassis		
E37	—	E350 Cutaway
Commercial Cutaway and Chassis		
E37	—	E350 Cutaway
Parcel Delivery		
E38	—	E350 Cutaway

F-SERIES CONVENTIONAL — GAS		
<u>Chassis Cab Code</u>	<u>Pick-Up Code</u>	<u>Basic Series</u>
	F10	F100
	F14	F150 4x4
F19	F15	F150
F27	F25	F250
	F26	F250 4x4
F37	F35	F350
	F36	F350 4x4

F-SERIES SUPER CAB — GAS		
<u>Chassis Cab Code</u>	<u>Pick-up Code</u>	<u>Basic Series</u>
X16	X14	F150 4x4
	X15	F150
X27	X25	F250
X28	X26	F250 4x4
X37	X35	F350
X38	X36	F350 4x4

SEQUENTIAL SERIAL AND WARRANTY NUMBER CODES (1980 MODEL YEAR)

ASSEMBLY PLANT CODES	
<u>Code</u>	<u>Assembly Plant</u>
B	Oakville
C	Ontario Truck
E	Mahwah
H	Lorain
K	Kansas City
L	Michigan Truck
N	Norfolk
P	Twin Cities
R	San Jose
S	Allen Park
U	Louisville

Bronco, LT Truck (F-100 thru F-350) and E-100 thru E-350 (Econoline and Club Wagon)	
<u>Code</u>	<u>Month and Year</u>
GA0, 000 — GB9, 999	August, 1979*
GD0, 000 — GE9, 999	September, 1979
GG0, 000 — GH9, 999	October, 1979
GJ0, 000 — GK9, 999	November, 1979
HA0, 000 — HB9, 999	December, 1979
HD0, 000 — HE9, 999	January, 1980
HG0, 000 — HH9, 999	February, 1980
HJ0, 000 — HK9, 999	March, 1980
JA0, 000 — JB9, 999	April, 1980
JD0, 000 — JE9, 999	May, 1980
JG0, 000 — JH9, 999	June, 1980
JJ0, 000 — JK9, 999	July, 1980
KA0, 000 — KE9, 999	August, 1980

*Job #1 — 1980 Model Year

WHEELBASE, ENGINE, EXTERIOR PAINT COLOR AND BODY TRIM CODES

WHEELBASE (Inches)

Bronco	
104	
F-100 thru F-350	
117	
133	155
137	161
139	
E-100 thru E-350 (Econoline and Club Wagon)	
124	
138	
158	

EXTERIOR PAINT COLOR CODE (2 CODES IF TWO TONED)

Refer to the Light Truck Body-Chassis and Electrical Shop Manuals, Group 10-00, for a complete listing of 1980 Truck Exterior Paint Codes.

BODY TRIM CODES

Refer to the Light Truck Body-Chassis and Electrical Shop Manuals (Group 10-00), for a complete listing of 1980 Truck Body Trim Codes.

ENGINE CODES

GAS ENGINE CODES — BRONCO			
<u>Code</u>	<u>Engine CID</u>	<u>Liter</u>	<u>Cyl.</u>
E	300-1V	4.9L	6
F	302-2V	5.0L	8
G	351-2V	5.8L	8

GAS ENGINE CODES — LT. TRUCK (F-100 thru F-350)			
<u>Code</u>	<u>Engine CID</u>	<u>Liter</u>	<u>Cyl.</u>
E	300-1V	4.9L	6
F	302-2V	5.0L	8
G	351-2V	5.8L	8
Z	400-2V	6.6L	8

GAS ENGINE CODES — E-100 THRU E-350 (Econoline and Club Wagon)			
<u>Code</u>	<u>Engine CID</u>	<u>Liter</u>	<u>Cyl.</u>
E	300-1V L.D.	4.9L	6
F	302-2V	5.0L	8
G*	351-2V	5.8L	8
W#	351-2V	5.8L	8
Z	400-2V	6.6L	8
L	460-4V	7.5L	8

E100 Windsor Only — E150 Less Leaded Fuel.

* E150 With Leaded Fuel — E250-E350.

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TYPE G.V.W. AND MAX. G.V.W. CODES

BRONCO		
Code	G.V.W.	
U150	5450	
U151	5700	
U152	6050	
U153	6300	

F-100 (4x2)		
Pickup Code	Chassis Cab Code	G.V.W.
F100	—	4650
F101	—	4700
F102	—	5000
F103	—	5150

F-150 (4x2)		
Pickup Code	Chassis Cab Code	G.V.W.
F150	—	5250
F151	—	5450
F152	—	5850
F153	—	6100

F150 (4x2) SUPER CAB		
Pickup Code	Chassis Cab Code	G.V.W.
X150	—	5750
X151	—	5950
X152	—	6100
X153	—	6300

F-150 (4x4)		
Pickup Code	Chassis Cab Code	G.V.W.
F140	—	5600
F141	—	5800
F142	—	6150
F143	—	6350

F-150 (4x4) SUPER CAB		
Pickup Code	Chassis Cab Code	G.V.W.
X140	—	6400
X143	—	6600

F-250 (4x2)		
Pickup Code	Chassis Cab Code	G.V.W.
F250	F270	6350
F251	F271	6900
F252	F272	7650
F253	F273	7800

F-250 (4x2) SUPER CAB		
Pickup Code	Chassis Cab Code	G.V.W.
X250	—	6350
X251	—	6600
X252	—	7150
X253	—	7600
X254	—	7750
X255	—	7850
X256	—	8000

F-250 (4x4)		
Pickup Code	Chassis Cab Code	G.V.W.
F260	—	6760
F261	—	7350
F262	—	8000
F266	—	8400

F-250 (4x4) SUPER CAB		
Pickup Code	Chassis Cab Code	G.V.W.
X260	—	6950
X261	—	8200

F-350 (4x2)		
Pickup Code	Chassis Cab Code	G.V.W.
F350	—	8650
F351	—	8700
F352	—	9950
F353	—	10,000
—	F376	8800
—	F377	9200
—	F378	9500
—	F379	10,000

F-350 (4x4)		
Pickup Code	Chassis Cab Code	G.V.W.
F360	—	8850
F361	—	9250

F-350 (4x4) SUPER CAB		
Pickup Code	Chassis Cab Code	G.V.W.
X350	—	8900

E-100 CLUB, CUSTOM, AND CHATEAU WAGONS		
Conv. Code	G.V.W.	
E010	5400	
E011	5700	
E012	5900	
E013	5800	
E014	6000	

E-150 CLUB, CUSTOM, AND CHATEAU WAGONS			
Conv. Code	Super Code	Conv. G.V.W.	Super G.V.W.
E110	S110	6400	6100
E111	S111	6300	6200
E112	S112	6200	6400
E113	S113	6400	6600
E114	S114	6600	6200
E115	S115	6200	6400
E116	S116	6500	6600
E117	—	6400	—
E119	—	6600	—

E-250 CLUB, CUSTOM, AND CHATEAU WAGONS			
Conv. Code	Super Code	Conv. G.V.W.	Super G.V.W.
E210	S210	6800	6900
E211	S211	7100	7200
E212	S212	7400	7400
E213	S213	7600	7500
E214	S214	7900	7700
E215	S215	8100	7900
E216	S216	6900	8100
E217	S217	7100	6900
E218	S218	7300	7200
E219	S219	7500	7400
—	S21A	—	7500
—	S21B	—	7700
—	S21C	—	8000
—	S21D	—	8300
—	S21E	—	7500
—	S21F	—	7700
—	S21G	—	7900
—	S21H	—	8200
E21J	S21J	7700	8500
E21K	S21K	8200	7700
—	S21L	—	7900
—	S21M	—	8100
—	S21N	—	8200
—	S21P	—	8300
E21R	S21R	8600	8400
E21S	—	8800	—

E-350 CLUB, CUSTOM, AND CHATEAU WAGONS	
Code (Super)	G.V.W.
S310	8600
S311	8800
S312	8600
S313	8800
S314	9000
S315	8600
S316	8900
S317	9200
S318	8900
S319	9200
S31J	9400

TYPE/GVW AND MAX. GVW CODES — CONTINUED

E-100 ECONOLINE CARGO, WINDOW, AND DISPLAY VANS			
Conv. Cargo Code	Conv. Window Code	Conv. Display Code	G.V.W.
E040	E050	E060	5200
E041	E051	E061	5550

E-150 ECONOLINE CARGO, WINDOW, AND DISPLAY VANS							
Conv. Cargo Code	Super Cargo Code	Conv. Window Code	Super Window Code	Conv. Display Code	Super Display Code	G.V.W. (Conv.)	G.V.W. (Super)
E140	S140	E150	S150	E160	S160	6200	6050
E141	S141	E151	S151	E161	S161	6300	6200

E-250 ECONOLINE CARGO, WINDOW, AND DISPLAY VANS							
Conv. Cargo Code	Super Cargo Code	Conv. Window Code	Super Window Code	Conv. Display Code	Super Display Code	G.V.W. (Conv.)	G.V.W. (Super)
E240	S240	E250	S250	E260	S260	6750	6500
E241	S241	E251	S251	E261	S261	7500	7100
E242	S242	E252	S2S2	E262	S262	8250	7900

E-350 ECONOLINE CARGO, WINDOW, AND DISPLAY VANS							
Conv. Cargo Code	Super Cargo Code	Conv. Window Code	Super Window Code	Conv. Display Code	Super Display Code	G.V.W. (Conv.)	G.V.W. (Super)
E340	S340	E350	S350	E360	S360	8550	9000
E341	S341	E351	S351	E361	S361	9500	9300
E342	—	E352	—	E362	—	9750	—

E-350 RV CUTAWAY		E-350 PARCEL DELIVERY VAN	
Code	G.V.W.	Code	G.V.W.
E370	8700 Single Rear	E380	8700 Single Rear
E371	8800 Dual Rear	E381	8750 Dual Rear
E372	9700 Single Rear	E382	9700 Dual Rear
E373	10,250 Dual Rear	E383	10,000 Dual Rear
E374	11,000 Dual Rear		

E-350 COMMERCIAL CUTAWAY		E-350 COMMERCIAL STRIP (DSO)	
Code	G.V.W.	Code	G.V.W.
E37M	10,250 (DSO)	E37P	8650
E37N	10,900 (DSO)	E37Q	9600
E37W	8900 Single Rear	E37U	9550
E37X	9200 Dual Rear	E37V	9800
E37Y	9700 Dual Rear		
E37Z	9750 Dual Rear		

TRANSMISSION AND AXLE CODES (REAR)

TRANSMISSION CODES

Code	Description
Bronco and F-100 thru F-350	
G	Automatic (Bronco)
C	Ford Manual 3-Speed
F	Warner 4-Speed Manual
A	New Process 4-Speed Manual
B	Clark Manual 4-Speed Overdrive
J	Automatic C4 (F-100/150)
K	Automatic C6 (F-100/350)
X	Automatic C-6 (Fleet Only)
Econoline — Club Wagon	
C	3-Speed Manual
G	Cruisomatic
B	Clark Manual 4-Speed Overdrive

AXLE CODES (REAR)

Code	Description	#Capacity	Ratio
Bronco and F-100 thru F-350			
06	Ford	2900	2.75
14	Ford	3750	3.00
15	Ford	3750	3.25
16	Ford	3750	3.50
13	Ford	3750	2.75
12	Ford	3750	4.11
H3	Limited Slip	3750	2.75
H2	Limited Slip	3750	3.50
H9	Limited Slip	3750	4.11
H4	Limited Slip	3750	3.25
23	Dana 61	5300	3.31
22	Dana 61	5300	3.07
24	Dana 60	5300	4.10
37	Dana 60	5300	3.54
38	Dana 60	5300	3.73
B4	Dana 60 Limited Slip	5300	4.10
C7	Dana 60 Limited Slip	5300	3.54
C8	Dana 60 Limited Slip	5300	3.73
27	Dana 70	7400	4.10
28	Dana 70	7400	4.56
36	Dana 70	7400	3.73
D7	Dana 70 Limited Slip	7400	4.10
E-100 thru E-350 (Non-Locking)			
13	Ford	3750	2.75
14	Ford	3750	3.00
15	Ford	3750	3.25
23	Dana	5300	3.31
37	Dana	5300	3.54
38	Dana	5300	3.73
36	Dana	7400	3.73
27	Dana	7400	4.10
E-100 thru E-350 (Locking)			
H3	Ford	3750	2.75
H4	Ford	3750	3.25
H7	Ford	3750	3.00
C3	Dana	5300	3.31
C7	Dana	5300	3.54
D7	Dana	7400	4.10

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FRONT AXLE AND D.S.O. CODES

DISTRICT SALES OFFICE (DSO) CODE

DSO — FSO — PTO (DOMESTIC, FOREIGN AND SPECIAL ORDER)

The D.S.O. space will show a two-digit code number of the district which ordered the unit (see chart below). This code will appear on all units — domestic or export. If unit is built on a D.S.O., E.S.O., P.T.O. (special orders), the complete order number is under the D.S.O. space after the district code.

FRONT AXLE CODES (Not Applicable On E-100 Thru E-350)

Bronco and F-100 Thru F-350

Adjustable Steering Column	Power Steering	Power Steering and Adjustable		Code	Front Axle
		Adjustable Steering Col.			
E	N	V	5	3850#	Front Axle
I	R	Z	9	4500#	Front Axle
B	K	S	2		Roll Bar
C	L	T	3		Roll Bar and 3850# Front Axle
D	M	U	4		Roll Bar and 4500# Front Axle

DISTRICT CODES

			Ford of Canada	
			Mercury Regions	Ford Regions
11 Boston	41 Chicago	71 Los Angeles	A1 Central	B1 Central
12 Buffalo	42 Cleveland	72 San Jose	A2 Eastern	B2 Eastern
13 New York	43 Milwaukee	73 Salt Lake City	A3 Atlantic	B3 Atlantic
14 Pittsburgh	45 Lansing	74 Seattle	A4 Midwestern	B4 Midwestern
15 Newark	46 Indianapolis	75 Phoenix	A6 Western	B6 Western
16 Philadelphia	47 Cincinnati	76 Denver	A7 Pacific	B7 Pacific
17 Washington	48 Detroit		A8 Great Lakes	B8 Great Lakes
		83 Government	12 Export	12 Export
21 Atlanta	52 Dallas	84 Home Office Reserve		
22 Charlotte	53 Kansas City	85 American Red Cross		
23 Memphis	54 Omaha	86 Recreation Vehicles		
24 Jacksonville	55 St. Louis	87 Body Company		
25 Richmond	56 Davenport	89 Transportation Services		
26 New Orleans	57 Houston	90's Export		
28 Louisville	58 Twin Cities	00 Special		

GASOLINE ENGINES

GROUP
21
(6000 &
9000)

PART TITLE	PAGE NO.	PART TITLE	PAGE NO.
General Gasoline Engine Service	21-01-1	5.8L (351 CID) M-V-8 and	
4.9L (300 CID) Six-Cylinder Engine	21-11-1	6.6L (400 CID) V-8 Engine	21-22-1
5.0L (302 CID) V-8 and 5.8L (351 CID)		7.5L (460 CID) V-8 Engine	21-24-1
W-V-8 Engine	21-21-1		

General Gasoline Engine Service

PART
21-01

SUBJECT	PAGE	SUBJECT	PAGE
DIAGNOSIS AND TESTING		REMOVAL AND INSTALLATION	
Camshaft End Play	21-01-7	Core Plugs	21-01-11
Camshaft Lobe Lift	21-01-6	Cup-Type	21-01-11
Crankshaft End Play	21-01-7	Expansion Type	21-01-11
Engine Oil Leaks	21-01-3	Crankshaft Rear Oil Seal	21-01-12
Flywheel Clutch Face Runout —		EGR Valve Removal	21-01-10
Manual-Shift Transmission	21-01-8	Exhaust Control Valve	21-01-10
Flywheel Runout —		Flywheel Ring-Gear —	
Automatic Transmission	21-01-8	Manual-Shift Transmission	21-01-13
Hydraulic Valve Lifter	21-01-5	Rocker Arm Stud Nut	
Positive Closed-Type Crankcase		Replacement — 4.9L (300 CID) I-6 .	21-01-8
Ventilation System	21-01-4	Rocker Arm Stud Replacement	
Compression Test	21-01-4	4.9L (300 CID) I-6	21-01-8
Timing Chain Deflection	21-01-7	SPECIFICATIONS	21-01-25
Timing Gear Backlash	21-01-7		
GENERAL INFORMATION	21-01-2		
Vehicle and Engine Identification	21-01-3		

GENERAL INFORMATION

All gasoline engines covered in this manual incorporate positive closed type crankcase ventilation systems and appropriate exhaust emission controls. The emission control systems are covered in detail in Group

29 of this volume and in Part 50-29 of Volume 5 (Pre-Delivery, Maintenance and Lubrication).

This part covers tests, adjustments, repair procedures, cleaning and inspections that are generally

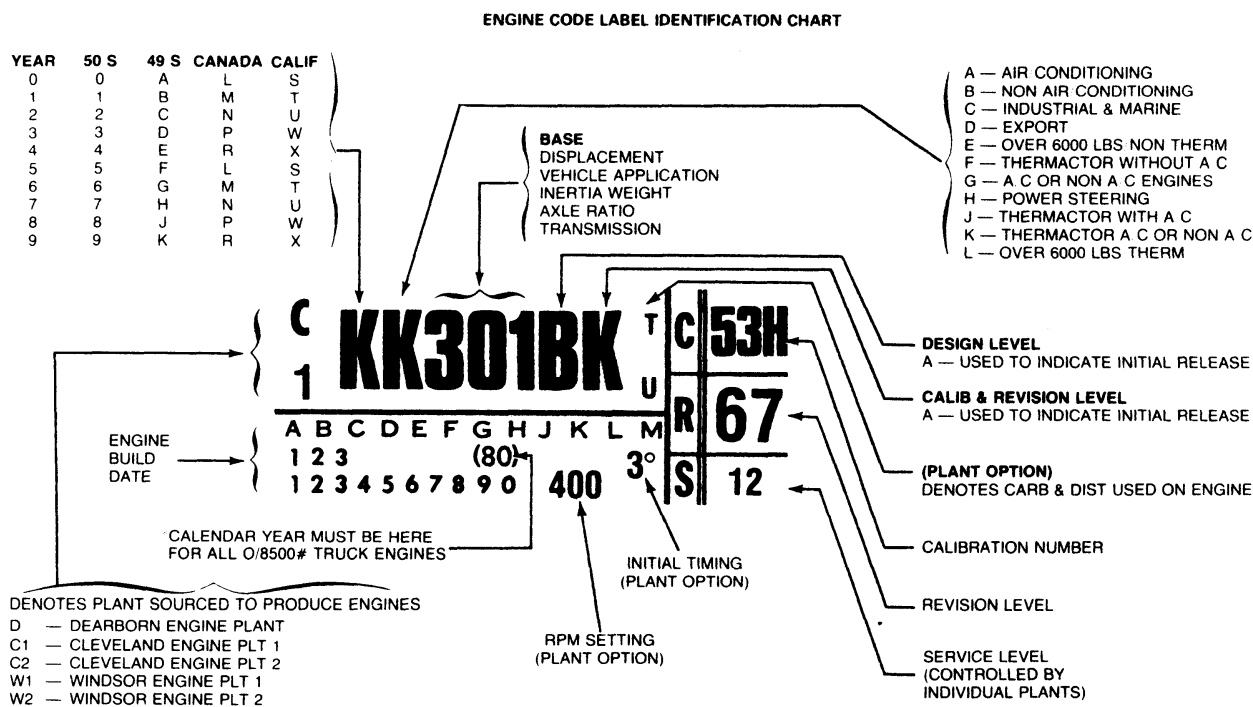
common to all or most gasoline engines covered in this manual. When performing tests, adjustments and repairs, it is essential to follow the procedures and specifications provided. Specifications are listed at the end of each pertinent engine part.

VEHICLE AND ENGINE IDENTIFICATION

Vehicle identification, the location of the vehicle rating and data plates and engine code information is fully covered in Group 20 of this volume. For specific and exact engine identification, a decal label is located either on the underside of the left front hood, radiator support bracket, or on the rocker arm cover depending on the vehicle model (Fig. 1). This identification label (Fig. 1) is located on the front of the valve

rocker cover on 6 cylinder engines and on the front of the right rocker cover on V-8 engines. Exceptions will occur if brackets or equipment would obscure the view of the label. On vehicles over 6000 GVWR the label is on the same engine component as the Emission Certification Decal.

Always refer to this label when replacement parts are required or when checking engine calibrations. Engine parts often are not the same within a CID family. The identification codes will insure that the proper parts are obtained. The codes contain all pertinent information relating to dates, optional equipment and revisions. The Ford Master Parts Catalog contains a complete listing of the codes and their application.



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FIG. 1 Engine Identification

DIAGNOSIS AND TESTING

ENGINE OIL LEAKS

When diagnosing engine oil leaks, it is important that the source and location of the leak be positively identified before any repairs are made. The following procedure has been found to be very effective and requires only a minimum of equipment available in most dealerships. Prior to using this procedure, it is important to clean the cylinder block, cylinder head(s), rocker cover(s), oil pan and flywheel housing areas with a suitable solvent to remove all traces of oil.

To perform oil leak diagnosis use tool 72-0003 or equivalent, or fabricate the following tool:

1. Air supply and air hose.
2. Air pressure gauge that registers pressure in one (1) psi increments.
3. Air line shut-off valve.
4. Appropriate fittings to attach the above parts to the oil fill and PCV valve grommet holes.
5. Appropriate plugs (bolts, rubber plugs) to seal all other openings leading to the crankcase, such as, oil level indicator (dipstick), tube, etc.
6. A solution of liquid detergent and water to be applied with a suitable type applicator such as a squirt bottle or brush.

Fabricate the air supply hose to include the air line shut-off valve and the appropriate adapter to permit the air to enter the engine through the PCV valve opening.

Fabricate the air pressure gauge to a suitable adapter for installation on the engine at the oil fill opening.

TESTING PROCEDURE

1. Open the air supply valve until the pressure gauge registers 5 psi (maintain 5 psi pressure).
2. Inspect the sealed and/or gasketed areas for leaks by applying Snoop Pressure Check or a solution of liquid detergent and water over the areas for the formation of bubbles, which indicates leakage. The areas to examine are:

Under Hood

- a. Rocker cover gasket.
- b. Cylinder front cover gasket.
- c. Intake manifold gaskets.
- d. Front and rear intake manifold end seals.
- e. Cylinder head gasket.
- f. Rubber grommets.
- g. Fuel pump seal and/or mounting gasket.
- h. Distributor O-ring.
- i. Oil level indicator (dipstick) tube connection.
- j. Oil pressure sending unit.
- k. Cup plugs and/or pipe plugs at the end of oil passages.

Under Engine—With Vehicle on Hoist

- a. Oil pan gasket.
- b. Front and rear oil pan end seals.
- c. Cylinder front cover gasket.
- d. Front crankshaft seal.
- e. Oil filter seal and/or adapter gasket.
- f. Oil cooler mounting gasket and/or cover plate gasket.

With Transmission and Flywheel Removed

- a. Rear crankshaft seal.
Air leakage in the area around a rope rear crankshaft oil seal does not necessarily indicate a rear seal leak. However, if no other cause can be found for oil leakage (air leaking from the rear oil pan seal, rear main bearing cap parting line, cup plugs, etc.) it can be assumed that the rope seal is the cause of the oil leakage.

A moderate amount of air leakage past the service split lip seal is also acceptable.

- b. Rear main bearing cap parting line.
- c. Rear main bearing cap end seals.
- d. Flywheel mounting bolt holes.
- e. Rear cup plugs and/or pipe plugs at the end of oil passages.

Oil leaks at crimped seams in sheet metal parts and cracks in cast or stamped parts can be detected when pressurizing the crankcase.

NOTE: Light foaming (similar to beer foam) equally around rocker arm cover bolts and crankshaft seals is not detrimental and no corrections are required in such cases.

POSITIVE CLOSED-TYPE CRANKCASE VENTILATION SYSTEM

A malfunctioning closed crankcase ventilation system may be indicated by loping or rough engine idle. Do not attempt to compensate for this idle condition by disconnecting the crankcase ventilation system and making carburetor adjustments. **The removal of the crankcase ventilation system from the engine will adversely affect the fuel economy and engine life.** To determine whether the loping or rough idle condition is caused by a malfunctioning crankcase ventilation system, refer to Emission System testing and diagnosis—Part 29-02, Light Duty Engine Diagnosis and Testing.

COMPRESSION TEST

The following procedure is to be used on all engines when checking compression:

1. Be sure the crankcase oil is of the correct viscosity and make sure that the battery is properly charged. Operate the engine for a minimum of 30 minutes at 1200 rpm, or until the engine is at normal operating temperature. Turn the ignition switch off; then remove all the spark plugs.
2. Set the carburetor throttle plates in the wide open position.
3. Install a compression gauge in No. 1 cylinder.
4. Crank the engine (with the ignition switch off) at least five pumping strokes and record the highest reading indicated. Note the approximate number of compression strokes required to obtain the highest reading.
5. Repeat the check on each cylinder cranking the engine approximately the same number of compression strokes.

TEST CONCLUSION

The indicated compression pressures are considered normal if the lowest reading cylinder is within 75 percent of the highest. Refer to the quick reference chart, (Fig. 2), for pressure limits between cylinders. Variations exceeding 75 percent implies an improperly seated valve or worn or broken piston rings. If one cylinder reads low, squirt approximately one tablespoon of engine oil on top of the pistons in the low reading cylinders. Repeat compression pressure check on these cylinders.

- a. If compression improves considerably, the piston rings are at fault.
- b. If compression does not improve, valves are sticking or seating poorly.
- c. If two adjacent cylinders indicate low compression pressures and squirting oil on the pistons does not increase the compression, the cause may be a cylinder head gasket leak between the cylinders. Engine oil and/or coolant in the cylinders could result from this problem.

Example

After checking the compression pressures in all cylinders, the highest reading obtained was 140 psi and the lowest pressure reading was 100 psi. By locating

Maximum PSI	Minimum PSI	Maximum PSI	Minimum PSI	Maximum PSI	Minimum PSI
134	101	174	131	214	160
136	102	176	132	216	162
138	104	178	133	218	163
140	105	180	135	220	165
142	107	182	136	222	166
144	108	184	138	224	168
146	110	186	140	226	169
148	111	188	141	228	171
150	113	190	142	230	172
152	114	192	144	232	174
154	115	194	145	234	175
156	117	196	147	236	177
158	118	198	148	238	178
160	120	200	150	240	180
162	121	202	151	242	181
164	123	204	153	244	183
166	124	206	154	246	184
168	126	208	156	248	186
170	127	210	157	250	187
172	129	212	158		

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FIG. 2 Quick Reference Compression Pressure Limit Chart

140 in the Maximum column it is seen that the lowest allowable pressure listed in the Minimum column is 105 psi. Since the lowest cylinder reading was 100 psi, the engine is not within specifications and the compression is not considered satisfactory.

HYDRAULIC VALVE LIFTER

Hydraulic tappet noise may be caused by any of the following:

1. Excessive collapsed tappet gap.
2. Sticking tappet plunger.
3. Tappet check valve not functioning properly.
4. Air in lubrication system.
5. Leakdown rate too rapid.
6. Excessive valve guide wear.

Excessive collapsed tappet gap may be caused by loose rocker arm fulcrum bolts, incorrect initial adjustment, or wear of tappet face, pushrod, rocker arm, rocker arm fulcrum or valve tip. With tappet collapsed (Part 21-02) check gap between valve tip and rocker arm to determine if any other valve train parts are damaged, worn, or out of adjustment.

A sticking tappet plunger may be caused by dirt, chips, or varnish inside the tappet. The sticking can be corrected by disassembling the tappet and removing the dirt, chips or varnish that is causing the condition.

A tappet check valve that is not functional may be caused by an obstruction such as dirt or chips preventing it from closing when the cam lobe is lifting the tappet, or it may be caused by a broken check valve spring.

Air bubbles in the lubrication system will prevent the tappet from supporting the valve spring load and may be caused by too high or too low an oil level in the oil pan, or by air being drawn into the system through a hole, crack, or leaking gasket on the oil pump pickup tube.

If the leakdown time is below the specified time for used tappets, noisy operation may result. If no other cause for noisy tappets can be found, the leakdown rate should be checked and any outside the specification should be replaced.

Assembled tappets can be tested with Tool 6500-E or equivalent to check the leakdown rate. The leak-down rate specification is the time in seconds for the plunger to move a specified distance of its travel while under a 50 lb. load. Test the tappets as follows:

1. Disassemble and clean the tappet to remove all traces of engine oil. **NOTE: Do not mix parts from different tappets. Parts are select-fitted and are not interchangeable.**

Tappets cannot be checked with engine oil in them. Only the testing fluid can be used.

2. Place the tappet in the tester, with the plunger facing upward. Pour hydraulic tester fluid into the cup to a level that will cover the tappet assembly. The fluid can be purchased from the manufacturer of the tester. Using kerosene or any other fluid will not provide an accurate test.
3. Place the 5/16-inch steel ball provided with the tester in the plunger cap (Fig. 3).
4. Adjust the length of the ram (Fig. 4) so that the pointer is 1/16 inch below the starting mark when the ram contacts the tappet plunger, to facilitate timing as the pointer passes the Start Timing mark.

Use the center mark on the pointer scale as the Stop Timing point instead of the original Stop Timing mark at the top of the scale.

5. Work the tappet plunger up and down until the tappet fills with fluid and all traces of air bubbles have disappeared.
6. Allow the ram and weight to force the tappet plunger downward. Measure the exact time it takes for the pointer to travel from the Start Timing to the Stop Timing marks of the tester.

7. A tappet that is satisfactory must have a leakdown rate (time in seconds) within the minimum and maximum limits specified.
8. If the tappet is not within specifications, replace it with a new tappet. It is not necessary to disassemble and clean new tappets before testing, because the oil contained in new tappets is test fluid.
9. Remove the fluid from the cup and bleed the fluid from the tappet by working the plunger up and down. This step will aid in depressing the tappet plungers when checking the valve clearance.

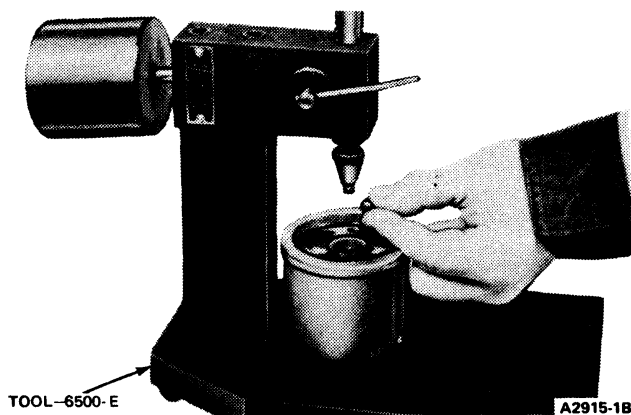


FIG. 3 Placing Steel Ball in Valve Lifter Plunger

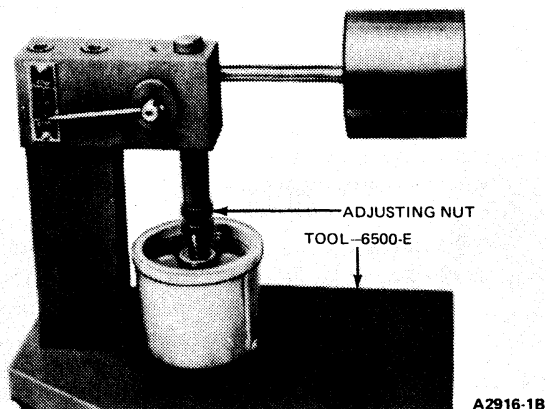


FIG. 4 Adjusting the Ram Length

CAMSHAFT LOBE LIFT

Check the lift of each lobe in consecutive order and make a note of the readings.

1. Remove the fresh air inlet tube and the air cleaner. Remove the heater hose and crankcase ventilation hoses. Remove valve rocker arm cover(s).
2. On 4.9L (300 CID) I-6, engines, remove the rocker arm stud nut, fulcrum seat and rocker arm. On 5.0L (302 CID) V-8 and 5-8L (351 CID) W-V-8 5.8L (351 CID) M-V-8, 6.6L (400 CID) V-8 engines, remove the fulcrum bolts, oil deflector, fulcrum seat and rocker arm.
3. Make sure the push rod is in the valve lifter socket. Install a dial indicator so that the actuating point of the indicator is in the push rod socket (or the

indicator ball socket adapter is on the end of the push rod) and in the same plane as the push rod movement (Fig. 5 or 6).

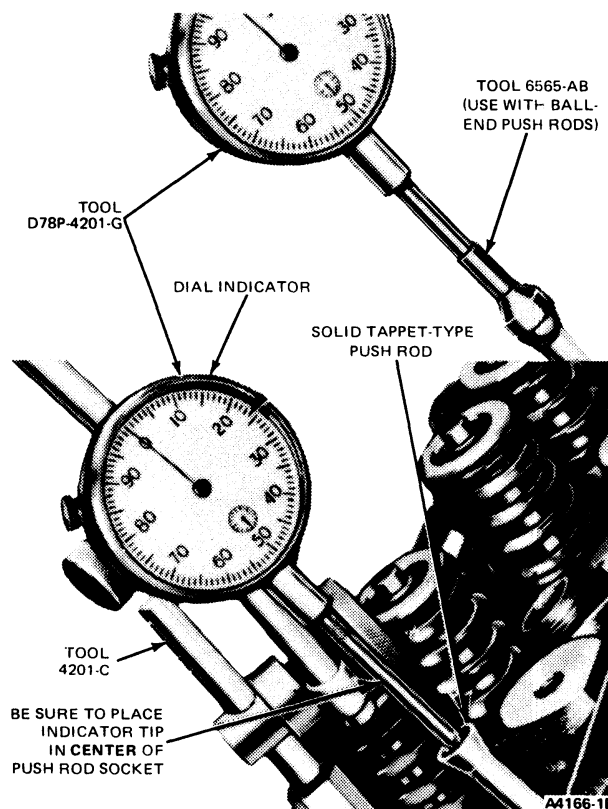


FIG. 5 Typical Camshaft Lobe Lift Hydraulic Valve Lifters—V-8 Engines

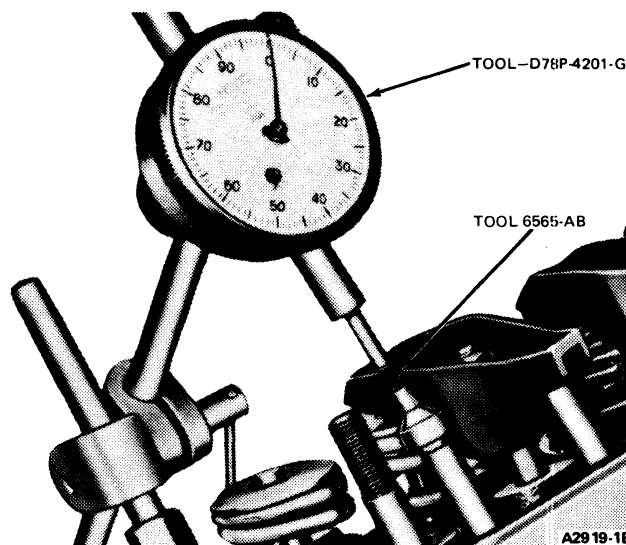


FIG. 6 Typical Camshaft Lobe Lift—4.9L (300 CID) I-6 Engines

4. Disconnect the brown lead (I terminal) and the red and blue lead (S terminal) at the starter relay. Install an auxiliary starter switch between the battery and S terminals of the starter relay. Crank the engine with the ignition switch OFF.

Turn the crankshaft over until the lifter is on the base circle of the camshaft lobe. At this point, the push rod will be in its lowest position.

5. Zero the dial indicator. Continue to rotate the crankshaft slowly until the push rod is in the fully raised position.
6. Compare the total lift recorded on the indicator with specification.
7. To check the accuracy of the original indicator reading, continue to rotate the crankshaft until the indicator reads zero. If the lift on any lobe is below specified wear limits, the camshaft and the valve lifters operating on the worn lobe(s) must be replaced.
8. Remove the dial indicator and auxiliary starter switch.

On 4.9L (300 CID) I-6, install the rocker arm, fulcrum seat and stud nut. On 5.0L (302 CID) V-8 and 5.8L (351 CID) W-V-8, 5.8L (351 CID) M-V-8, and 6.6L (400 CID) V-8 install the rocker arm, fulcrum seat, oil deflector and fulcrum bolts. Adjust the valve clearance.

9. Install the valve rocker arm cover(s) and the air cleaner.

CAMSHAFT END PLAY

On all V-8 engines, prying against the aluminum-nylon camshaft sprocket, with the valve train load on the camshaft, can break or damage the sprocket. Therefore, the rocker arm adjusting nuts must be backed off, or the rocker arm and shaft assembly must be loosened sufficiently to free the camshaft. After checking the camshaft end play, adjust the valve clearance.

Push the camshaft toward the rear of the engine. Install a dial indicator so that the indicator point is on the camshaft sprocket attaching screw (Fig. 7). Zero the dial indicator. Position a large screwdriver between the camshaft gear and the block. Pull the camshaft forward and release it. Compare the dial indicator reading with the specifications listed at the end of the applicable engine Part.

If the end play is excessive, check the spacer for correct installation before it is removed. If the spacer is correctly installed, replace the thrust plate.

Remove the dial indicator.

TIMING CHAIN DEFLECTION

1. Rotate the crankshaft in a counterclockwise direction (as viewed from the front) to take up the slack on the left side of the chain.
2. Establish a reference point on the block and measure from this point to the chain (Fig. 8).
3. Rotate the crankshaft in the opposite direction to take up the slack on the right of the chain. Force the left side of the chain out with the fingers and measure the distance between the reference point and the chain. The deflection is the difference between the two measurements.

If the deflection exceeds specifications, replace the timing chain and sprockets.

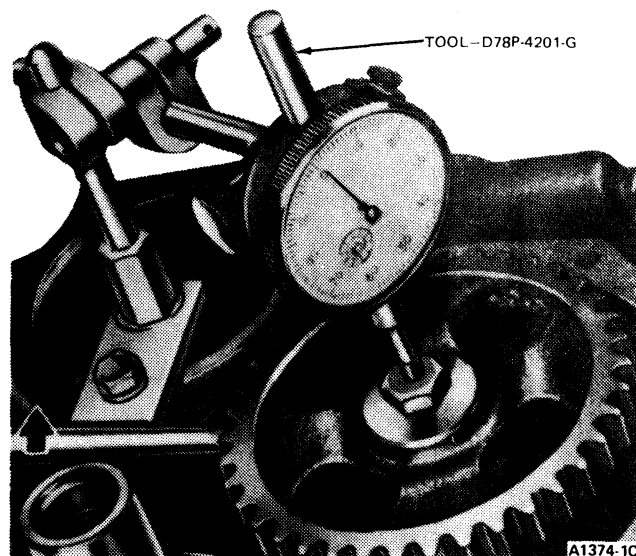


FIG. 7 Checking Camshaft End Play

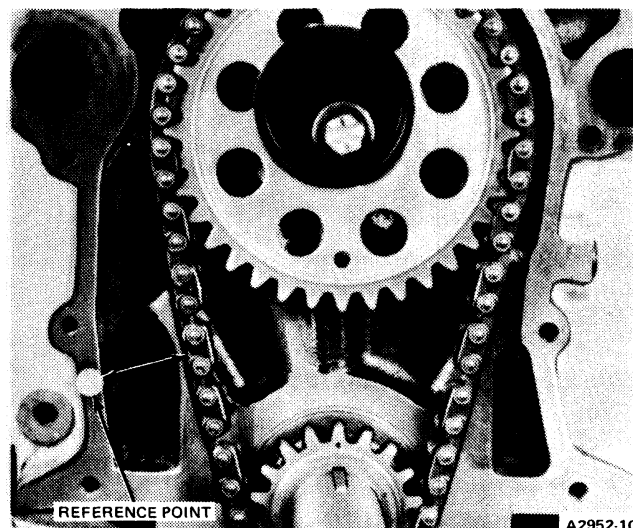


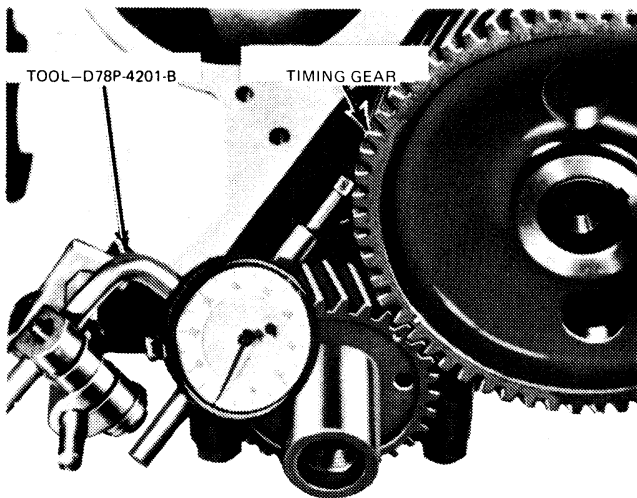
FIG. 8 Checking Timing Chain Deflection

TIMING GEAR BACKLASH

Install a dial indicator on the cylinder block (Fig. 9). Check the backlash between the camshaft gear and the crankshaft gear with a dial indicator at six equally spaced teeth. Hold the gear firmly against the block while making the check. Refer to specifications for the backlash limits.

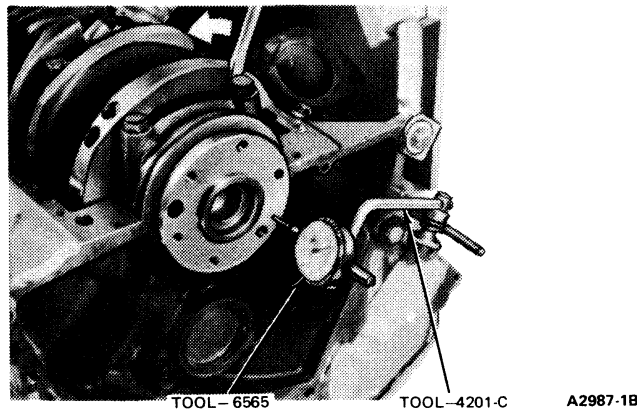
CRANKSHAFT END PLAY

1. Force the crankshaft toward the rear of the engine.
2. Install a dial indicator so that the contact point rests against the crankshaft flange and the indicator axis is parallel to the crankshaft axis (Fig. 10).
3. Zero the dial indicator. Push the crankshaft forward and note the reading on the dial.
4. If the end play exceeds the wear limit, replace the thrust bearing. If the end play is less than the minimum limit, inspect the thrust bearing faces for



A2923-1D

FIG. 9 Checking Timing Gear Backlash



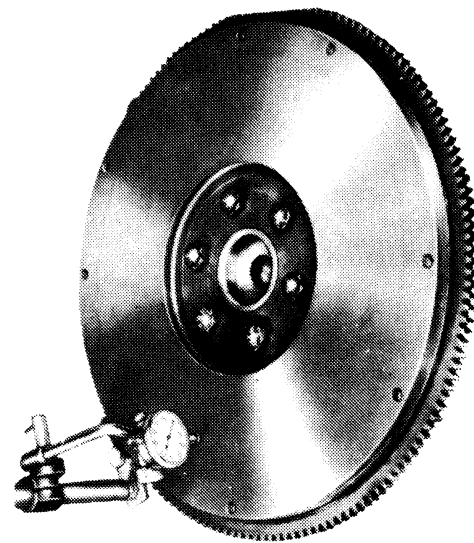
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FIG. 10 Checking Crankshaft End Play

scratches, burrs, nicks, or dirt. If the thrust faces are not damaged or dirty, they probably were not aligned properly. Install the thrust bearing and align the faces following the procedure recommended under Main Bearing Replacement in the pertinent engine Part. Check the crankshaft end play.

FLYWHEEL CLUTCH FACE RUNOUT— MANUAL-SHIFT TRANSMISSION

Install a dial indicator so that the indicator point bears against the flywheel face (Fig. 11). Turn the flywheel making sure that it is full forward or rearward so that crankshaft end play will not be indicated as flywheel runout.



A3111-1A

**FIG. 11 Checking Flywheel Face Runout—
Manual Transmission**

If the flywheel clutch face runout exceeds specifications, remove the flywheel and check for burrs between the flywheel and the face of the crankshaft mounting flange. If no burrs exist, check the runout of the crankshaft mounting flange. Replace the flywheel or machine the crankshaft-flywheel mounting face if the mounting face flange runout is excessive. If the ring gear runout exceeds specifications, check installation of the gear to the flywheel flange. If it is not properly seated, re-install it to the flywheel. If it is properly seated, replace it. Refer to Ring Gear Replacement in this Part for the proper procedure.

FLYWHEEL RUNOUT—AUTOMATIC TRANSMISSION

Remove the spark plugs.

Install a dial indicator so that the indicator point rests on the face of the ring gear adjacent to the gear teeth.

Push the flywheel and crankshaft forward or backward as far as possible to prevent crankshaft end play from being indicated as flywheel runout.

Set the indicator dial on the zero mark. Turn the flywheel one complete revolution while observing the total indicator reading (TIR). If the TIR exceeds specifications, the flywheel and ring gear assembly must be replaced.

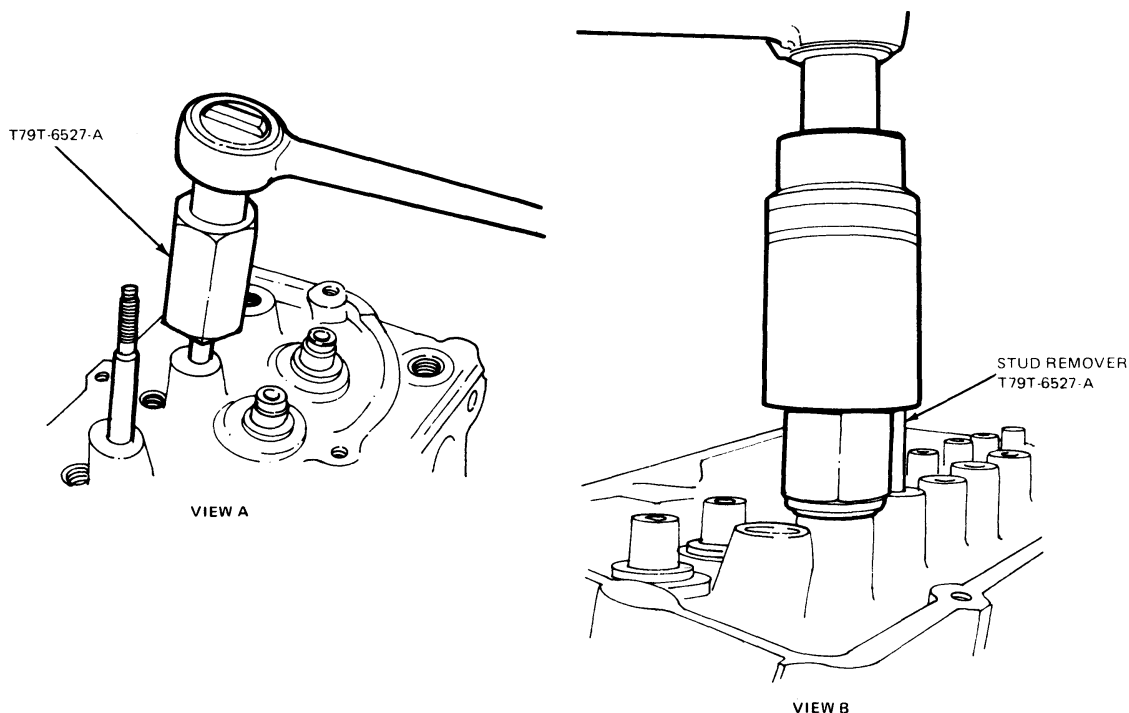
REMOVAL AND INSTALLATION

ROCKER ARM STUD NUT REPLACEMENT— 4.9L (300 CID) I-6

If the rocker arm stud nut breakaway torque is less than specified, install a new standard stud nut and recheck the breaking torque. Refer to Valve Clearance Adjustment in Part 21-11 for the torque procedure.

ROCKER ARM STUD REPLACEMENT—4.9L (300 CID) I-6

If it is necessary to remove a rocker arm stud, Tool T79T-6527-A is available. A 0.006 oversize reamer T62F-6527-B3 or equivalent and a 0.015 inch oversize reamer T62F-6527-B5 or equivalent are



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FIG. 12 Removing Rocker Arm Stud—4.9L (300 CID)

available. For 0.010 inch oversize studs, use reamer T66P-6527-B or equivalent. To press in replacement studs, use stud replacer T79T-6527-B or equivalent for 4.9L (300 CID) I-6 (Fig. 14).

Rocker arm studs that are broken or have damaged threads may be replaced with standard studs. Loose studs in the head may be replaced with 0.006, 0.010 or 0.015 inch oversize studs which are available for service.

Standard and oversize studs can be identified by measuring the stud diameter within 1 1/8 inch from the pilot end of the stud. The stud diameters are:

0.006 oversize . . . 0.3774-0.7781

0.010 oversize . . . 0.3814-0.3821

0.015 oversize . . . 0.3864-0.3871

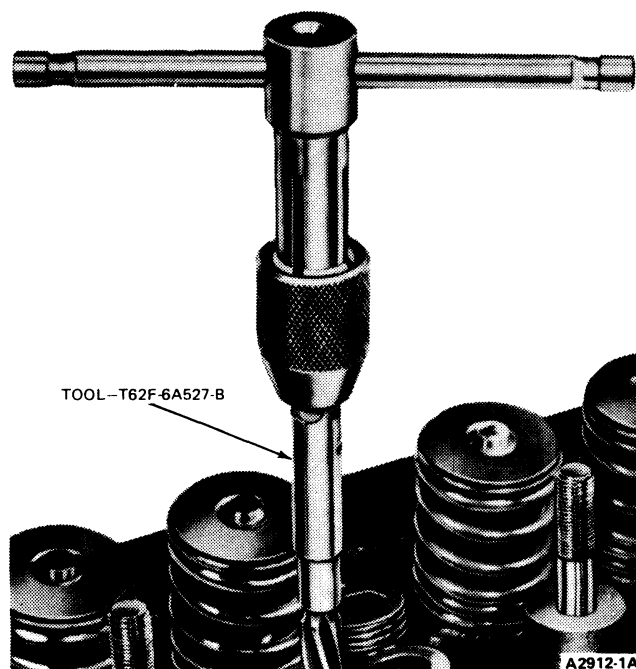
When going from a standard size rocker arm stud to a 0.010 or 0.015 inch oversize stud, always use the 0.006 inch oversize reamer before finish reaming with the 0.010 or 0.015 inch oversize reamer.

1. Position the sleeve of the rocker arm stud remover over the stud with the bearing end down. Thread the puller into the sleeve and over the stud until it is fully bottomed. Hold the sleeve with a wrench; then, rotate the puller clockwise to remove the stud (Fig. 12).

If the rocker arm stud was broken off flush with the stud boss, use an easy-out to remove the broken stud following the instructions of the tool manufacturer.

2. If a loose rocker arm stud is being replaced, ream the stud bore using the proper reamer (or reamers in sequence) for the selected oversize stud (Fig. 13).

Make sure the metal particles do not enter the valve area.



A2912-1A

FIG. 13 Reaming Rocker Arm Stud—4.9L (300 CID)

3. Coat the end of the stud with Lubriplate or it's equivalent. Align the stud D with the stud bore;

then, tap the sliding driver until it bottoms (Fig. 14). When the driver contacts the stud boss, the stud is installed to its correct height.

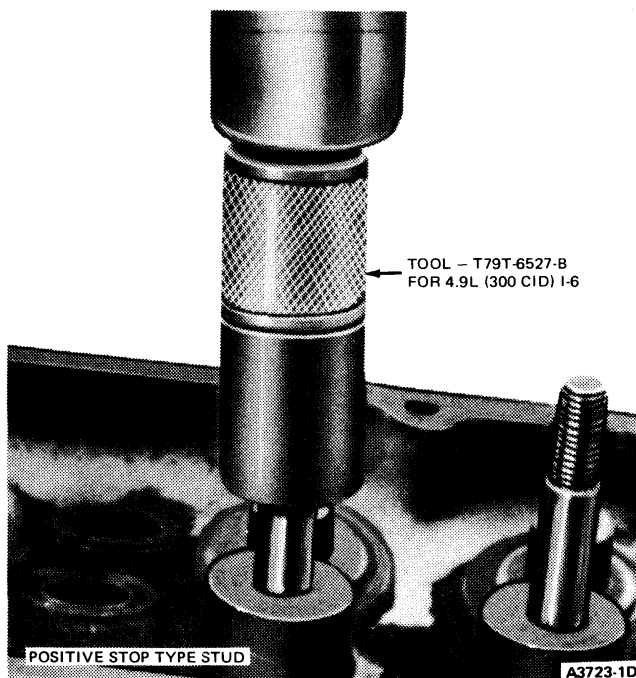


FIG. 14 Installing Rocker Arm Stud—4.9L (300 CID)

EXHAUST CONTROL VALVE

Removal

4.9L (300 CID) I-6 engines utilize a thermostatic spring and counterweight type exhaust control valve which is integral with the exhaust manifold, (Fig. 15). Service procedures are covered under Emission Systems Service, Part 29-01 and Part 50-26 of Volume 5, Pre-Delivery, Maintenance and Lubrication.

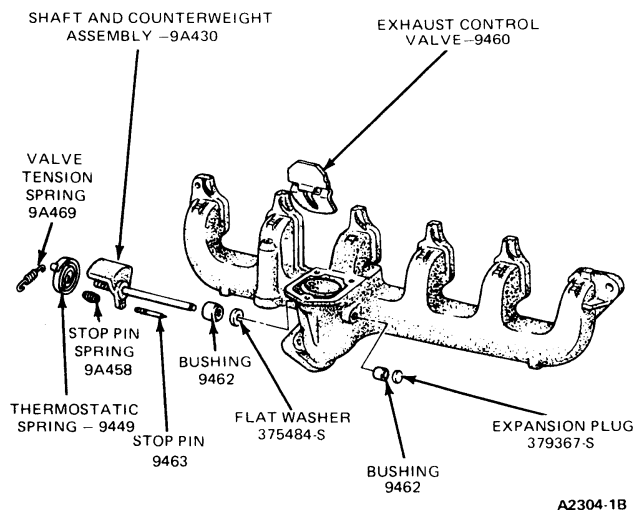


FIG. 15 Exhaust Manifold Assembly

2. Remove the valve tension spring and the thermostatic spring from the exhaust control valve shaft (Fig. 15).
3. Remove the stop pin spring from the manifold.
4. Using an acetylene torch inside the manifold, cut the shaft on both sides of the valve plate.
5. Remove the valve plate, shaft and flat washer.
6. Remove the expansion plug from the control valve shaft bushing bore.
7. Remove the exhaust control valve bushings from the manifold using soft drift punch and hammer. These bushings come in two sizes each, both front and rear. To determine which bushings should be used, measure the outside diameter of the removed bushings. Replace with the proper parts (Fig. 16).

Installation

1. Install the new control valve bushings using soft drift punch and hammer. The inner end of the smaller bushing should be 0.010-0.015 inch below the inner surface of the exhaust manifold. The inner end of the larger bushing should be 0.020 inch above the inner surface of the exhaust manifold.
2. Ream the bushings to 0.251-0.253 inch ID.
3. Slide the new shaft into the bushing, flat washer and valve plate. The flat washer must be between the valve plate and the large bushing.
4. Install a new stop pin spring on the stop pin.
5. Position the exhaust control valve at an 84 degree angle with the top surface of the manifold (Fig. 17).
6. Rotate the counterweight and shaft assembly clockwise until the counterweight contacts the stop pin spring. Place a 0.030 inch feeler gauge between the counterweight and manifold to maintain the specified clearance while welding.
7. With the plate and counterweight in position, use stainless steel welding rod to tack-weld the valve plate to the shaft.
8. Move the assembly back and forth to check for a binding condition. If there is no binding condition, securely weld the valve plate to the shaft.
9. Install the expansion plug in the manifold bushing bore.
10. Position the new thermostatic spring on the shaft and counterweight assembly so that it will be necessary to wind the spring approximately one-half turn in the clockwise direction to hook the open end over the stop pin. Use a 5/16 inch ID piece of tubing to slide the thermostatic spring on the shaft and counterweight assembly. Wind the spring clockwise and hook it over the stop pin.
11. Install a new valve tension spring on the exhaust control valve shaft and the stop pin.

EGR VALVE REMOVAL

Do not strike or pry on the valve diaphragm housing or supports, as this may damage the valve operating mechanism and/or change the valve calibration. Refer to Part 29-07 for removal and installation procedures.

1. Separate the intake and exhaust manifolds.

Part Number	Bushing	Outside Diameter of Bushing	Inside Diameter of Bushing Bore in Manifold
(Front—Std.)	C5AZ-9462-A	0.3070-0.3065	0.3061-0.3051
(Rear—Std.)	C5AZ-9462-B	0.6255-0.6250	0.6246-0.6236
(Front—0.010 O.S.)	C5AZ-9462-C	0.3170-0.3165	0.3161-0.3151
(Rear—0.010 O.S.)	C5AZ-9462-D	0.6355-0.6350	0.6346-0.6336

Note: Dimensions are in inches

CA1026-2B

**FIG. 16 Exhaust Control Valve Bushing Sizes—
4.9L (300 CID) I-6 Six-Cylinder Engine Only**

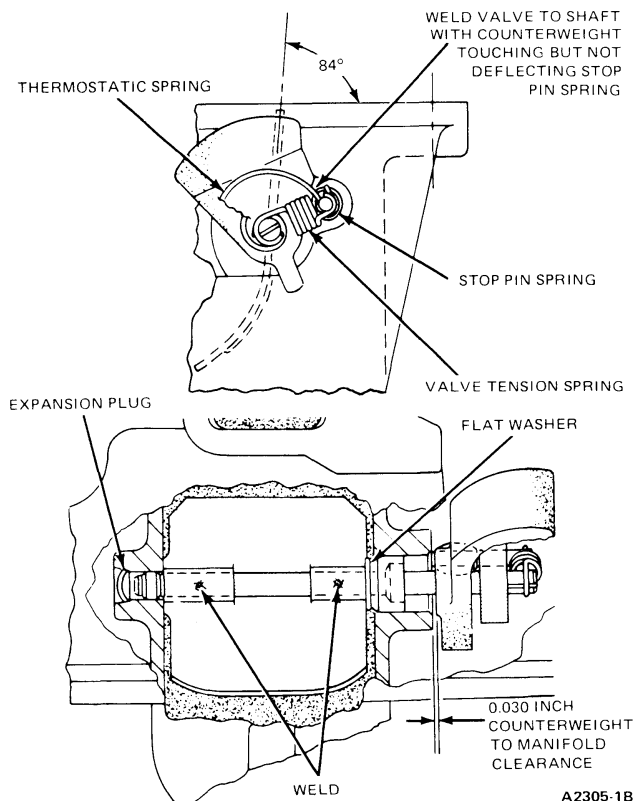


FIG. 17 Valve Plate Position and Counterweight Clearance

CORE PLUGS

Removal and Installation

To remove a large core plug, drill a 1/2 inch hole in the center of the plug and remove with a universal impact slide hammer T59L-100-B and T50T-100-A or equivalent or pry it out with a large drift punch. On a small core plug, drill a 1/4 inch hole in the center of the plug and pry it out with a small pin punch. Clean and inspect the plug bore.

Prior to installing a core plug the plug bore should be inspected for any damage that would interfere with the proper sealing of the plug. If the bore is damaged it will be necessary to true the surface by boring for the next specified oversize plug.

Oversize (OS) plugs are identified by the OS stamped in the flat located on the cup side of the plug.

Coat the plug and/or bore lightly with an oil-resistant (oil galley) or water-resistant (cooling jacket) sealer and install it following the procedure for cup type or expansion type below:

CUP-TYPE

Cup-type core plugs (Fig. 18) are installed with the flanged edge outward. The maximum diameter of this plug is located at the outer edge of the flange. The flange on cup-type plugs flares outward with the largest diameter at the outer (sealing) edge.

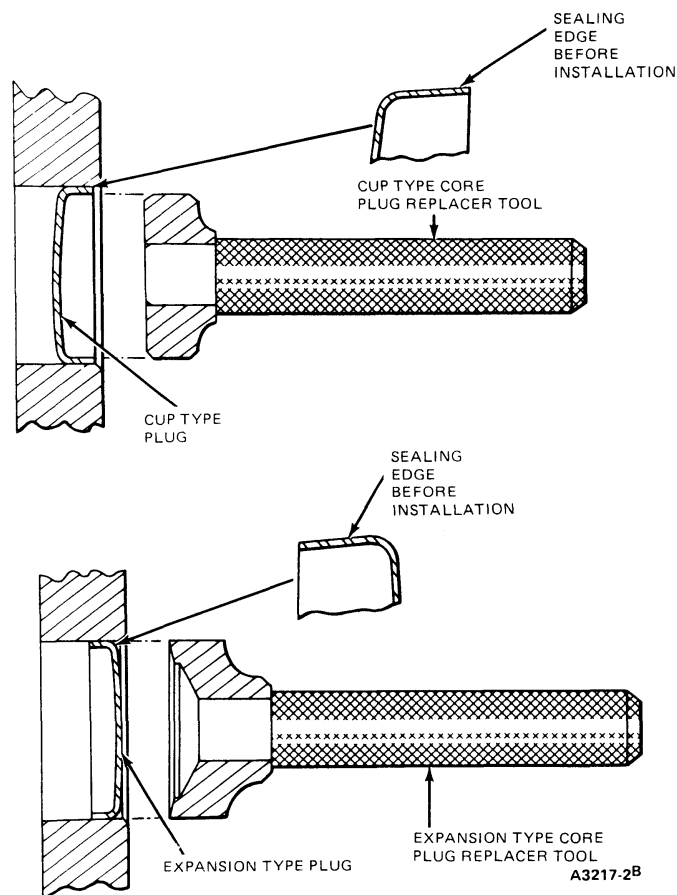


FIG. 18 Typical Core Plugs and Installation Tools

It is imperative to pull the plug into the machined bore by using a properly designed tool. Under no circumstances is the plug to be driven into the bore using a tool that contacts the flange. This method will damage the sealing edge and will result in leakage and/or plug blow out.

The flanged (trailing) edge must be below the chamfered edge of the bore to effectively seal the plugged bore.

If the core plug replacing tool has a depth seating surface, do not seat the tool against a non-machined (casting) surface.

EXPANSION-TYPE

Expansion-type core plugs (Fig. 18) are installed with the flanged edge inward. The maximum diameter of this plug is located at the base of the flange with the flange flaring inward.

It is imperative to push or drive the plug into the machined bore using a properly designed tool. Under no circumstances is the plug to be driven using a tool that contacts the crowned portion of the plug. This method will expand the plug prior to installation and may damage the plug and/or plug bore.

When installed the trailing (maximum) diameter must be below the chamfered edge of the bore to effectively seal the plugged bore.

If the core plug replacing tool has a depth seating surface, do not seat the tool against a non-machined (casting) surface.

CRANKSHAFT REAR OIL SEAL

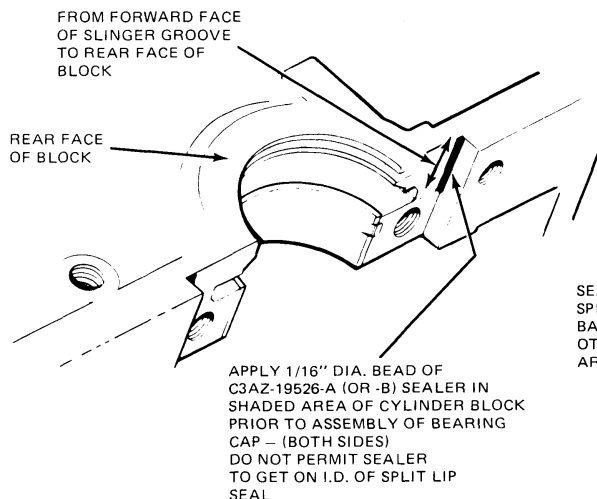
A split-lip type crankshaft rear oil seal is provided for servicing all engines except 4.9L (300 CID) I-6. The complete seal is replaced without removing the crankshaft on a 4.9L (300 CID) I-6 engine. Follow procedure in applicable engine Part for all other engines.

Removal

1. Remove the oil pan and the oil pump (if required).
2. Loosen all the main bearing cap bolts, thereby lowering the crankshaft slightly but not to exceed 1/32 inch.
3. Remove the rear main bearing cap, and remove the oil seal from the bearing cap and cylinder block. On the block half of the seal use a seal removal tool, or install a small metal screw in one end of the seal, and pull on the screw to remove the seal. **Exercise caution to prevent scratching or damaging the crankshaft seal surfaces.**
4. Remove the oil seal retaining pin from the bearing cap if so equipped. **The pin is not used with the split-lip seal.**

Installation

1. Carefully clean the seal groove in the cap and block with a brush and solvent such as lacquer thinner, Ford Spot Remover, B7A-19521-A or equivalent, or trichlorethylene. Also, clean the area where sealer is later to be applied (Fig. 19). Dry the area thoroughly, so that no solvent touches the seal.
2. Dip the split lip-type seal halves in clean engine oil.
3. Carefully install the upper seal (cylinder block) into its groove with undercut side of seal toward the FRONT of the engine (Fig. 20), by rotating it on the seal journal of the crankshaft until approximately 3/8 inch protrudes below the parting surface.



SEALER APPLICATION SKETCH
SPLIT LIP TYPE SEAL SHOWN
BASIC APPLICATION AREAS FOR
OTHER SEAL INSTALLATIONS
ARE THE SAME.

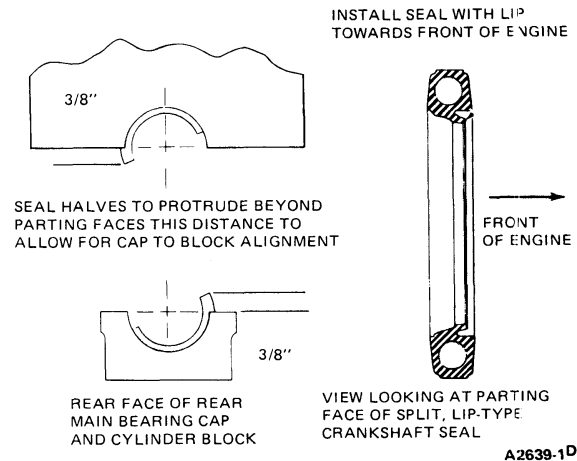


FIG. 20 Installing Crankshaft Rear Oil Seal

Be sure no rubber has been shaved from the outside diameter of the seal by the bottom edge of the groove. Do not allow oil to get on the sealer area (Fig. 19).

4. Tighten the remaining bearing cap bolts to specifications.
5. Install the lower seal in the rear main bearing cap with undercut side of seal toward the FRONT of the engine (Fig. 20), allow the seal to protrude approximately 3/8 inch above the parting surface to mate with the upper seal when the cap is installed.
6. Apply an even 1/16 inch bead of RTV silicone rubber sealer, (C3AZ-19562-B or equivalent), to the areas shown on Fig. 19, following the procedure given in the illustration.

NOTE: This sealer sets-up in 15 minutes.

Install the rear main bearing cap. Tighten the cap bolts to specifications.

7. Install the oil pump and oil pan. Fill the crankcase with the proper amount and type of oil.
8. Operate the engine and check for oil leaks.

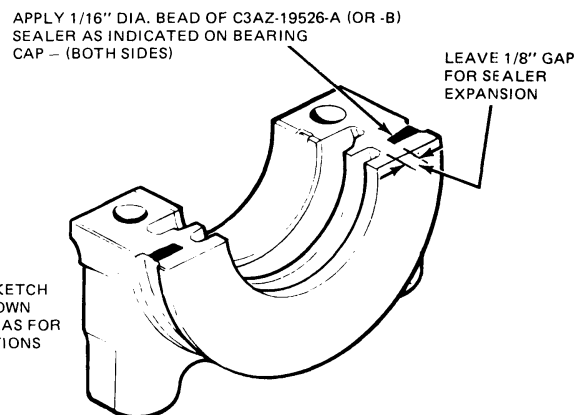


FIG. 19 Applying RTV Sealer to Main Bearing Cap and Block

FLYWHEEL RING GEAR—MANUAL-SHIFT TRANSMISSION

Removal

To replace a damaged or worn ring gear, heat the ring gear with a blow torch on the engine side of the gear, and knock it off the flywheel. **Do not hit the flywheel when removing the ring gear.**

Installation

Heat the new ring gear evenly until the gear expands enough to slip onto the flywheel. Make sure the gear is seated properly against the shoulder. **Do not heat any portion of the gear to a temperature higher than 500 degrees F. If this limit is exceeded, the hardness will be removed from the ring gear teeth.**

OVERHAUL

INTERPRETATION OF "SERVICE LIMIT" SPECIFICATIONS

"Service Limit" specifications are intended to be a guide only, to be used when overhauling or reconditioning an engine or engine component. A determination can be made whether a component is suitable for continued service or should be replaced for extended service while the engine is disassembled.

In the case of "Valve Stem to Valve Guide Clearance," the "Service Clearance" is intended as an aid in diagnosing engine noise only, and does not constitute a failure or indicate need for repair. However, when overhauling or reconditioning a cylinder head, the service clearance should be regarded as a practical working value, and used as a determinant for installing the next oversize valve to assure extended service life.

CYLINDER HEAD

Replace the head if it is cracked. **Do not plane or grind more than 0.010 inch from the cylinder head gasket original surface.** Remove all burrs or scratches with an oil stone.

REAMING VALVE GUIDES

If it becomes necessary to ream a valve guide (Fig. 21) to install a valve with an oversize stem, a reaming kit is available which contains the following reamer and pilot combinations: 0.003 inch OS reamer with a standard diameter pilot, a 0.015 inch OS reamer with a 0.003 inch OS pilot, and a 0.030 inch reamer with a 0.015 inch OS pilot.

When replacing a standard size valve with an oversize valve always use the reamer in sequence (smallest oversize first, then next smallest, etc.) so as not to overload the reamers. **Always re-face the valve seat after the valve guide has been reamed, and use a suitable scraper to break the sharp corner (ID) at the top of the valve guide.**

REFACING VALVE SEATS

Refacing of the valve seat should be closely coordinated with the refacing of the valve face so that the finished seat and valve face will be concentric and the specified interference fit will be maintained. This is important so that the valve and seat will have a compression tight fit. Be sure that the refacer grinding wheels are properly dressed.

Grind the valve seats of all engines to a true 45 degree angle (Fig. 22). Remove only enough stock to clean up pits and grooves or to correct the valve seat

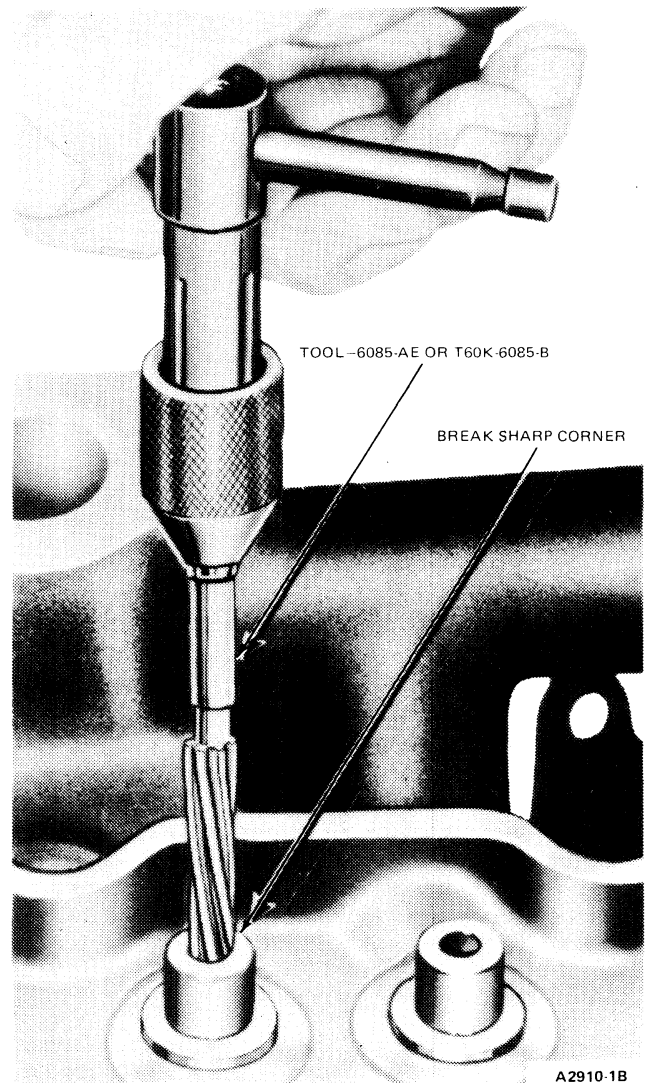


FIG. 21 Reaming Valve Guides

runout. After the seat has been refaced, use a seat width scale or a machinist scale to measure the seat width (Fig. 23). Narrow the seat, if necessary to bring it within specifications.

If the valve seat width exceeds the maximum limit, remove enough stock from the top edge and/or bottom edge of the seat to reduce the width to specifications.

On the valve seats of all engines use a 60 degree angle grinding wheel to remove stock from the bottom of the seats (raise the seats) and use a 30 degree angle

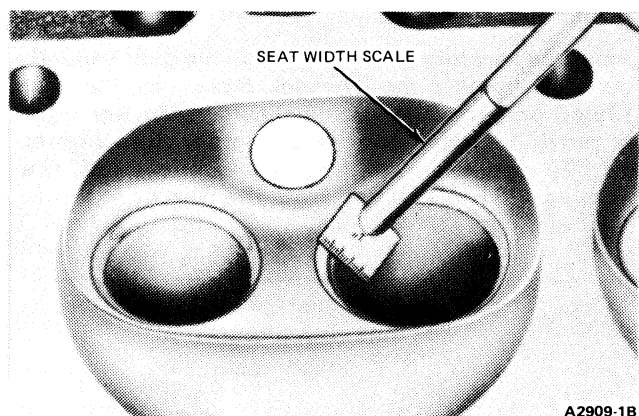


FIG. 22 Refacing Valve Seat

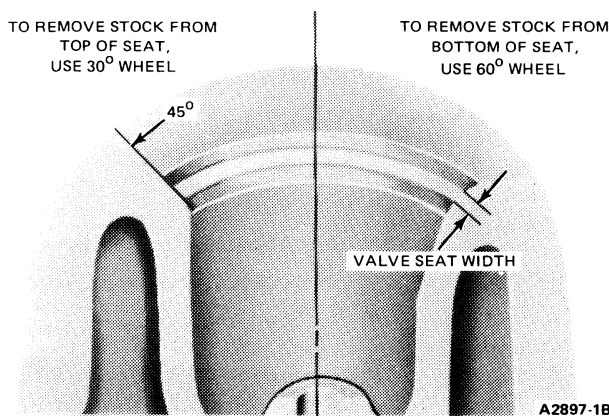


FIG. 23 Checking Valve Seat Width

wheel to remove stock from the top of the seats (lower the seats).

The finished valve seat should contact the approximate center of the valve face. It is good practice to determine where the valve seat contacts the face. To do this, coat the seat with Prussian blue and set the valve in place. Rotate the valve with light pressure. If the blue is transferred to the center of the valve face, the contact is satisfactory. If the blue is transferred to the top edge of the valve face, lower the valve seat. If the blue is transferred to the bottom edge of the valve face, raise the valve seat.

VALVES

Minor pits, grooves, etc., may be removed. Discard valves that are severely damaged, or if the face runout cannot be corrected by refinishing or if stem clearance exceeds specifications.

Discard any worn or damaged valve train parts.

REFACING VALVES

The valve refacing operation should be closely coordinated with the valve seat refacing operations so that the finished angles of the valve face and of the valve seat will be to specifications and provide a compression tight fit. Be sure that the refacer grinding wheels are properly dressed.

If the valve face runout is excessive and/or to remove pits and grooves, reface the valves to a true 44

degree angle. Remove only enough stock to correct the runout or to clean up the pits and grooves. If the edge of the valve head is less than 1/32 inch thick after grinding (Fig. 24), replace the valve as the valve will run too hot in the engine. **The interference fit of the valve and seat should not be lapped out.**

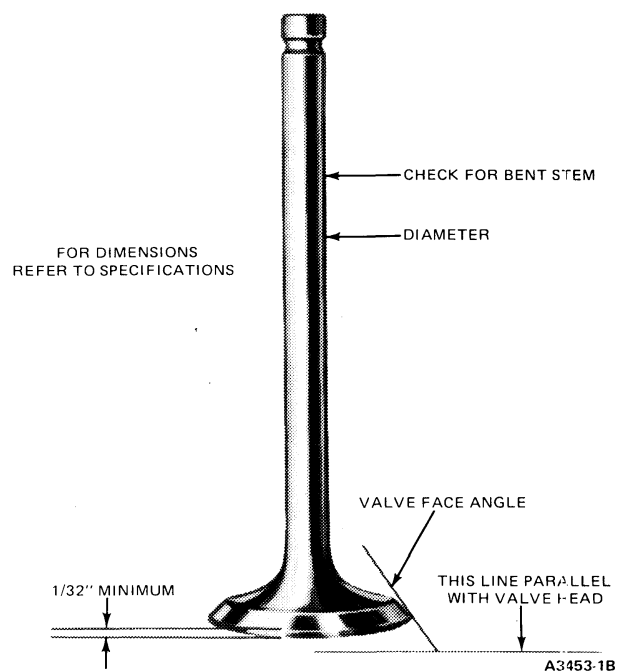


FIG. 24 Critical Valve Dimensions

Remove all grooves or score marks from the end of the valve stem, and chamfer it as necessary. **Do not remove more than 0.010 inch from the end of the valve stem.**

If the valve and/or valve seat has been refaced, it will be necessary to check the clearance between the rocker arm pad and the valve stem with the valve train assembly installed in the engine.

SELECT FITTING VALVES

If the valve stem to valve guide clearance exceeds the service limit, ream the valve guide for the next oversize valve stem. Valves with oversize stem diameters of 0.003, 0.015 and 0.030 inch are available for service. **Always reface the valve seat after the valve guide has been reamed. Refer to Reaming Valve Guides.**

CAMSHAFT REPAIR

Remove light scuffs, scores or nicks from the camshaft machined surfaces with a smooth oil stone.

CRANKSHAFT

Dress minor scores with an oil stone. If the journals are severely marred or exceed the service limit, they should be refinished to size for the next undersize bearing.

REFINISHING JOURNALS

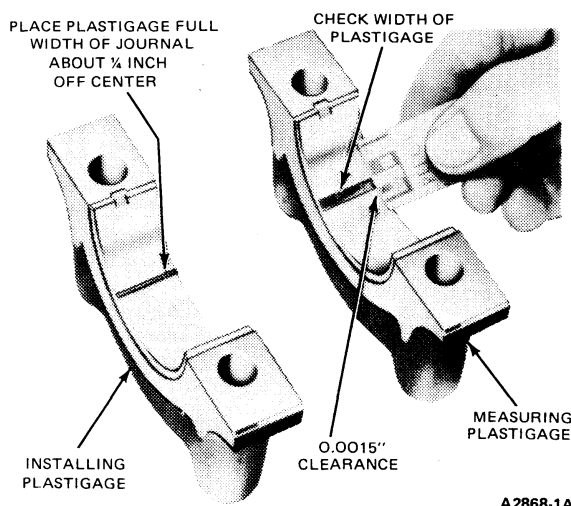
Refinish the journals to give the proper clearance with the next undersize bearing. If the journal will not clean up to maximum undersize bearing available, replace the crankshaft.

Always reproduce the same journal shoulder radius that existed originally. Too small a radius will result in fatigue failure of the crankshaft. Too large a radius will result in bearing failure due to radius ride of the bearing.

After refinishing the journals, chamfer the oil holes; then polish the journal with a No. 320 grit polishing cloth and engine oil. Crocus cloth may also be used as a polishing agent.

FITTING MAIN OR CONNECTING ROD BEARINGS WITH PLASTIGAGE

1. Clean crankshaft journals. Inspect journals and thrust faces (thrust bearing) for nicks, burrs or bearing pick-up that would cause premature bearing wear. When replacing standard bearings with new bearings, it is good practice to fit the bearing to minimum specified clearance. If the desired clearance cannot be obtained with a standard bearing, try one half of a 0.001 or 0.002 inch undersize in combination with a standard bearing to obtain the proper clearance.
2. If fitting a main bearing, position a jack under counterweight adjoining bearing which is being checked. **Do not place jack under front post of crankshaft.** Support crankshaft with jack so its weight will not compress Plastigage and provide an erroneous reading.
3. Place a piece of Plastigage or it's equivalent, on bearing surface across full width of bearing cap and about 1/4 inch off center (Fig. 25).



A2868-1A

FIG. 25 Installing and Measuring Plastigage—Engine Installed

4. Install cap and tighten bolts to specifications. Do not turn crankshaft while Plastigage is in place.
5. Remove cap. Using Plastigage scale, check width of Plastigage at widest point to get minimum

clearance. Check at narrowest point to get maximum clearance. Difference between readings is taper of journals.

6. If clearance exceeds specified limits, try 0.001 or 0.002 inch undersize bearings in combination with the standard bearings. Bearing clearance must be within specified limits. If 0.002 inch undersize main bearings are used on more than one journal, be sure they are all installed in cylinder block side of bearing. If standard and 0.002 inch undersize bearings do not bring clearance within desired limits, refinish crankshaft journal, then install undersize bearings.
7. After bearing has been fitted, apply light coat of engine oil to journal and bearings. Install bearing cap. Tighten cap bolts to specifications.
8. Repeat procedures for remaining bearings that require replacement.

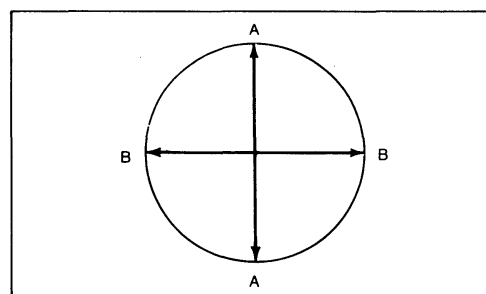
PISTONS, PINS AND RINGS

FITTING PISTONS

Pistons are available in standard size or oversize for service. Refer to the Ford Parts Master Catalog for available oversize pistons.

The standard size pistons are color coded red or blue, or have 0.003 OS stamped on the dome. Refer to the Specifications for standard size piston dimensions.

Measure the cylinder bore, (Fig. 26) and select the piston to assure the proper clearance. When the bore diameter is in the lower one third of the specified range, a red piston should be used. When the bore diameter is in the middle one third a blue piston should be used. When the bore diameter is the upper one third, the 0.003 OS piston should be used.



A — At right angle to center line of engine

B — Parallel to center line of engine

Top Measurement: Make 1/2 inch below top of block deck

Bottom Measurement: Make within 1/2 inch above top of piston—when piston is at its lowest travel (B.D.C.)

Bore Service Limit: Equals the average of "A" and "B" when measured at the center of the piston travel.

Taper: Equals difference between "A" top and "A" bottom.

Out-of-Round: Equals difference between "A" and "B" when measured at the center of piston travel.

Refer to Specification tables at end of each engine part.

A4165-2D

FIG. 26 Cylinder Bore Measurement

Measure the piston diameter to ensure that the specified clearance is obtained. It may be necessary periodically to use another piston (within the same grade size) that is either slightly larger, or smaller to achieve the specified clearance.

If none can be fitted, refinish the cylinder to provide the proper clearance for the piston.

When a piston has been fitted, mark it for assembly in the cylinder to which it was fitted.

If the taper, out-of-round and piston to cylinder bore clearance conditions of the cylinder bore are within specified limits, new piston rings will give satisfactory service. **If new rings are to be installed in a used cylinder that has not been refinished, remove the cylinder wall glaze (refer to Cylinder Block, Refinishing Cylinder Walls). Be sure to clean the cylinder bore thoroughly.**

1. Calculate the size piston to be used by taking a cylinder bore check. Follow the procedures outlined under Cleaning and Inspection.
2. Select the proper size piston to provide the desired clearance (refer to the specifications). Measure the piston diameter in line with the centerline of the piston pin and at 90 degrees to the piston pin axis.
3. Make sure the piston and cylinder block are at room temperature (70 degrees F). After any refinishing operation allow the cylinder bore to cool, and make sure the piston and bore are clean and dry before the piston fit is checked.

FITTING RINGS

1. Select the proper ring set for the size cylinder bore.
2. Position the ring in the cylinder bore in which it is going to be used.
3. Push the ring down into the bore area where normal ring wear is not encountered.
4. Use the head of a piston to position the ring in the bore so that the ring is square with the cylinder wall. Use caution to avoid damage to the ring or cylinder bore.
5. Measure the gap between the ends of the ring with a feeler gauge (Fig. 27). If the ring gap is less or greater than the specified limits, try another ring set.

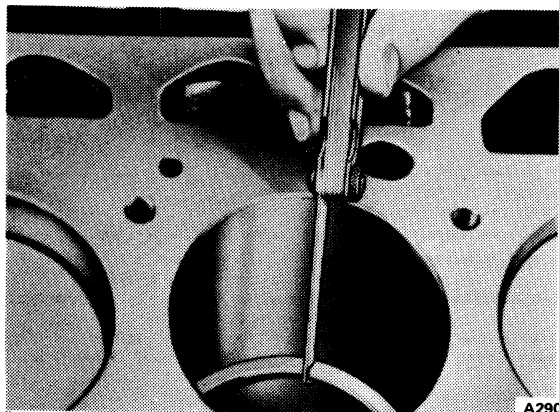


FIG. 27 Checking Piston Ring Gap

6. Check the ring side clearance of the compression rings with a feeler gauge inserted between the ring and its lower land (Fig. 28). The gauge should slide freely around the entire ring circumference without binding. Any wear that occurs will form a step at the inner portion of the lower land. If the lower

lands have high steps, the piston should be replaced.

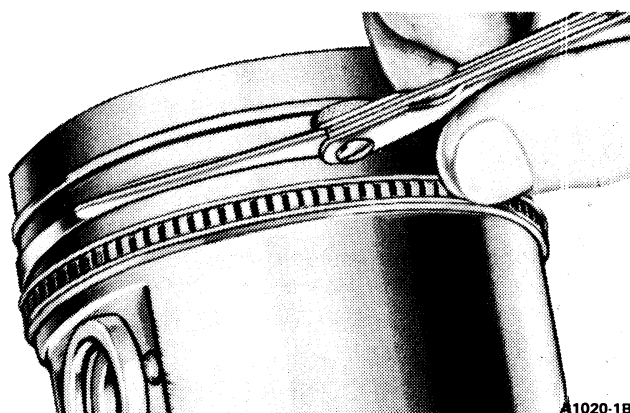


FIG. 28 Checking Piston Ring Side Clearance

FITTING PISTON PINS—4.9L (300 CID) I-6, 5.0L (302 CID) V-8, 5.8L (351 CID) W-V-8 and, 6.6L (351 CID) M-V-8, 6.6L (400 CID) V-8 and 7.5L (460 CID) V-8

On these engines install the piston pin, following the procedure under Piston Assembly in the applicable engine Part.

CYLINDER BLOCK

REFINISHING CYLINDER WALLS

Honing is recommended for refinishing cylinder walls only when there is no visible sign of cross hatching (hone pattern) remaining, the walls have minor scuffs or scratches, or for fitting pistons to the specified clearance. The grade of hone to be used is determined by the amount of metal to be removed. Follow the instructions of the hone manufacturer. If coarse stones are used to start the honing operation, leave enough material so that all hone marks can be removed with the finishing hone which is used to obtain the proper piston clearance. Thoroughly clean the cylinder bore walls with detergent and water solution after honing.

Cylinder walls that are severely marred and/or worn beyond the specified limits should be refinished. **Before any cylinder is refinished, all main bearing caps must be in place and tightened to the proper torque, so that the crankshaft bearing bores will not become distorted from the refinishing operation.**

Refinish only the cylinder or cylinders that require it. All pistons are the same weight, both standard and oversize; therefore, various sizes of pistons can be used without upsetting engine balance.

Refinish the cylinder with the most wear first to determine the maximum oversize. If the cylinder will not clean up when refinished for the maximum oversize piston recommended, replace the block.

Refinish the cylinder to within approximately 0.0015 inch of the required oversized diameter. This will allow enough stock for the final step of honing so that the correct surface finish and pattern are obtained.

For the proper use of the refinishing equipment, follow the instructions of the manufacturer. Only

experienced personnel should be allowed to perform this work.

Use a motor-driven, spring pressure-type hone at a speed of 300-500 rpm. Hones of grit sizes 180-220 will normally provide the desired bore surface finish. When honing the cylinder bores, use a lubricant mixture of equal parts of kerosene and SAE No. 20 Motor Oil. Operate the hone in such a way as to produce a cross-hatch finish on the cylinder bore. The cross-hatch pattern should be at an angle of approximately 30 degrees to the cylinder bore.

After the final operation in either of the two refinishing methods described and prior to checking the piston fit, thoroughly clean the cylinder walls with detergent and water solution, dry thoroughly and oil the cylinder walls. Mark the pistons to correspond to the cylinders in which they are to be installed. When the refinishing of all cylinders that require it has been completed and all pistons are fitted, thoroughly clean the entire block and oil the cylinder walls.

REPAIRING ENGINE CASTINGS HAVING SAND HOLES OR BEING POROUS

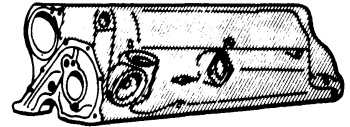
Porosity or sand hole(s) which will cause oil seepage or leakage can occur with modern casting processes. A complete inspection of engine and transmission should be made. If the leak is attributed to the porous condition of the cylinder block or sand hole(s), repairs can be made with metallic plastic (CAZ-19554-A or an equivalent metallic plastic). **Do not repair cracks with this material. Repairs with this metallic plastic must be confined to those cast iron engine component surfaces (Fig. 29) where the inner wall surface is not exposed to engine coolant pressure or oil pressure.** For example:

- Cylinder block surfaces extending along the length of the block, upward from the oil pan rail to the cylinder water jacket but not including machined areas.
- Lower rear face of the cylinder block.
- Intake manifold casting. Repairs are not recommended to the intake manifold exhaust crossover section since temperature can exceed the recommended temperature limit of 260°C (500° F).
- Cylinder front cover on engines using cast iron material.
- Cylinder head, along the rocker arm cover gasket surface.

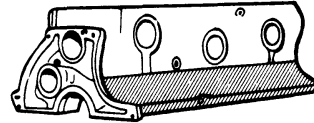
The following procedures should be used to repair porous areas or sand holes in cast iron:

- Clean the surface to be repaired by grinding or rotary filing to a clean bright metal surface. Chamfer or undercut the hole or porosity to a greater depth than the rest of the cleaned surface. Solid metal must surround the hole. Openings larger than 1/4 inch should not be repaired using metallic plastic. Openings in excess of 1/4 inch can

SHADED AREAS MAY BE REPAIRED WITH EPOXY

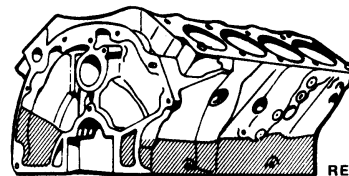
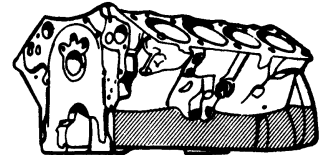


FRONT AND LEFT SIDE
TYPICAL FOR 1-4 AND 1-6 ENGINES



REAR AND RIGHT SIDE

FRONT AND LEFT SIDE
TYPICAL FOR V-6 AND V-8 ENGINES



REAR AND RIGHT SIDE

A2386-1D

FIG. 29 Typical Cast Iron Cylinder Block Areas Repairable with Metallic Plastic (Indicated by Shaded Areas)

- be drilled, tapped and plugged using common tools. Clean the repair area thoroughly. Metallic plastic will not stick to a dirty or oily surface.
- Mix the metallic plastic base and hardener as directed on the container. Stir thoroughly until uniform.
- Apply the repair mixture with a suitable clean tool (putty knife, wood spoon, etc.) forcing the metallic plastic into the hole or porosity.
- Allow the repair mixture to harden. This can be accomplished by two methods; heat cure with a 250 watt lamp placed 10 inches from the repaired surface, or air dry for 10-12 hours at temperatures above 10°C (50° F).
- Sand or grind the repaired area to blend with the general contour of the surrounding surface.
- Paint the surface to match the rest of the block.

CLEANING AND INSPECTION

The cleaning and inspection procedures are for a complete engine overhaul; therefore, for partial engine overhaul or parts replacement, follow the pertinent cleaning or inspection procedure.

CRANKCASE VENTILATION SYSTEM

Refer to the Truck Maintenance and Lubrication Manual for the correct mileage interval for maintenance. Service following procedures in Part 29-02.

VALVE ROCKER ARM AND/OR SHAFT ASSEMBLY

Cleaning

Clean all the parts thoroughly. Make sure that all oil passages are open.

On ball stud rocker arms, make sure the oil passage in the push rod end of the rocker arm is open.

If necessary, remove the plugs from both ends of the rocker arm shaft to thoroughly clean the shaft passages.

Inspection

On rocker arm shaft assemblies, check the clearance between each rocker arm and the shaft by checking the ID of the rocker arm bore and the OD of the shaft. If the clearance between any rocker arm and the shaft exceeds specified limits, replace the shaft and/or the rocker arm. Inspect the shaft and the rocker arm bore for nicks, scratches, scores, or scuffs.

Inspect the pad at the valve end of the rocker arms for indications of scuffing or abnormal wear. If the pad is grooved, replace the rocker arm. **Do not attempt to true this surface by grinding.**

Check the rocker arm adjusting screws and the push rod end of the rocker arms for stripped or broken threads, and the ball end of the adjusting screw for nicks, scratches, or excessive wear.

On the ball stud rocker arms, check the rocker arm and fulcrum seat for excessive wear, cracks, nicks or burrs. Check the rocker arm stud and nut for stripped or broken threads.

VALVE ROCKER ARM COVERS

Check the gasket surfaces for damage caused by over-tightened bolts. Straighten the surface as required to restore original flatness.

PUSH RODS

Cleaning

Clean all push rods in a suitable solvent. On push rods with an oil passage, blow out the passage with compressed air.

Inspection

Check the ends of the push rods for nicks, grooves, roughness or excessive wear.

The push rods can be visually checked for straightness while they are installed in the engine by rotating them with the valve closed. They also can be checked with a dial indicator (Fig. 30).

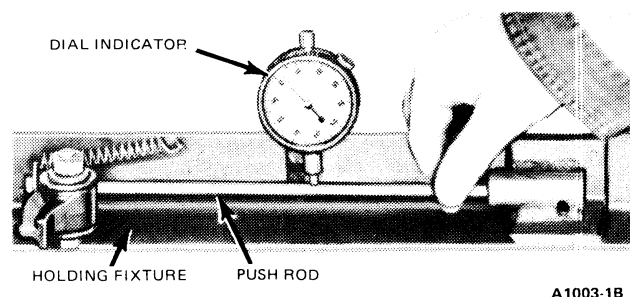


FIG. 30 Checking Push Rod Runout

CYLINDER HEADS

Cleaning

With the valves installed to protect the valve seats, remove deposits from the combustion chambers and valve heads with a scraper and a wire brush. **Be careful not to damage the cylinder head gasket surface.** After the valves are removed, clean the valve guide bores with a valve guide cleaning tool. Using cleaning solvent to remove dirt, grease and other deposits, clean all bolt holes; be sure the oil transfer passage is clean (V-8 engines).

Remove all deposits from the valves with a fine wire brush or buffing wheel.

Inspection

Inspect the cylinder heads for cracks or excessively burned areas in the exhaust outlet ports.

Check the cylinder head for cracks and inspect the gasket surface for burrs and nicks. Replace the head if it is cracked.

On cylinder heads that incorporate valve seat inserts, check the inserts for excessive wear, cracks or looseness.

The following inspection procedures are for a cylinder head that is to be completely overhauled. For individual repair operations, use only the pertinent inspection procedure.

CYLINDER HEAD FLATNESS

When a cylinder head is removed because of gasket leaks, check the flatness of the cylinder head gasket surface (Fig. 31) for conformance to specifications. If necessary to refinish the cylinder head gasket surface, do not plane or grind off more than 0.010 inch from the original gasket surface.

VALVE SEAT RUNOUT

Check the valve seat runout with an accurate gauge (Fig. 32). Follow the instructions of the gauge manufacturer. If the runout exceeds the service limit, reface the valve and valve seat.

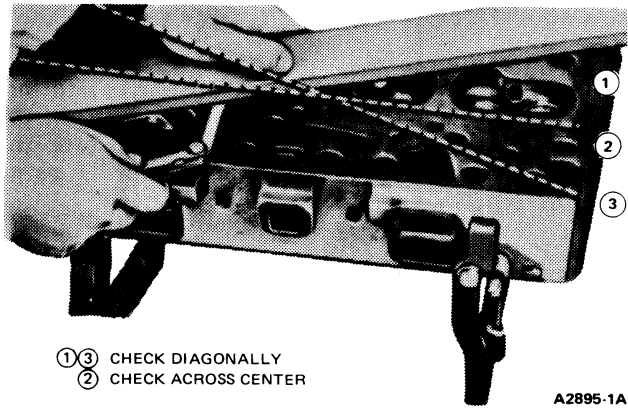


FIG. 31 Checking Cylinder Head Flatness

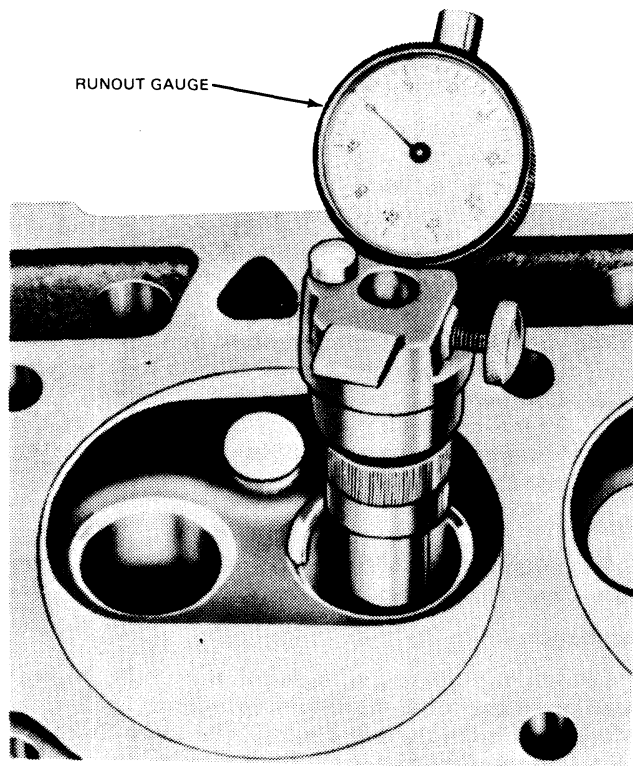


FIG. 32 Checking Valve Seat Runout

VALVE SEAT WIDTH

Measure the valve seat width (Fig. 23). Reface the valve seat(s) if the width is not within specifications.

VALVES

The critical inspection points and tolerances of the valve are illustrated in Fig. 24. Refer to specifications for service limits.

Inspect the valve face and the edge of the valve head for pits, grooves or scores. Inspect the stem for a bent condition and the end of the stem for grooves or scores. Check the valve head for signs of burning or erosion, warpage and cracking. Minor pits, grooves, etc., may be removed. Discard severely damaged valves.

Inspect the valve springs, valve spring retainers, locks and sleeves and discard any visually damaged parts.

VALVE FACE RUNOUT

Check the valve face runout. It should not exceed the specified service limit. If the runout exceeds the service limit, the valve should be replaced or refaced as outlined under Refacing Valves in this Part.

VALVE STEM CLEARANCE

Check the valve stem to valve guide clearance of each valve in its respective valve guide with the tool shown in Fig. 33 or its equivalent. Use a flat end indicator point.

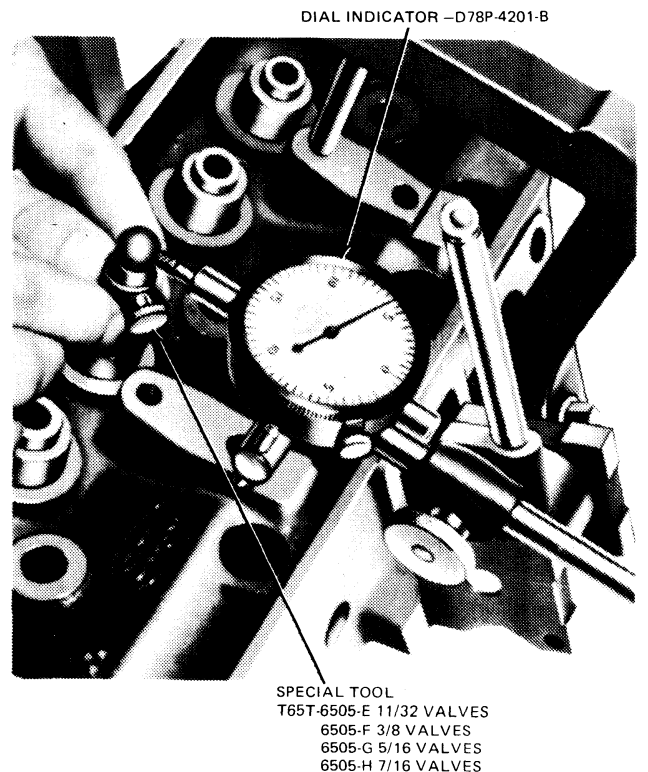


FIG. 33 Checking Valve Stem Clearance

Install the tool on the valve stem until it is fully seated, and tighten the knurled set screw firmly. Permit the valve to drop away from its seat until the tool contacts the upper surface of the valve guide.

Position the dial indicator with its flat tip against the center portion of the tool's spherical section at approximately 90 degrees to the valve stem axis. Move the tool back and forth in line with the indicator stem. Take a reading on the dial indicator without removing the tool from the valve guide upper surface. Divide the reading by two, the division factor for the tool.

VALVE SPRING PRESSURE

Check the valve spring for proper pressure (Fig. 34) at the specified spring lengths. Weak valve springs cause poor performance; therefore, if the pressure of any spring is lower than the service limit, replace the spring.

APPLY TORQUE UNTIL CLICK IS HEARD, READ TORQUE WRENCH AND MULTIPLY READING BY TWO (2).

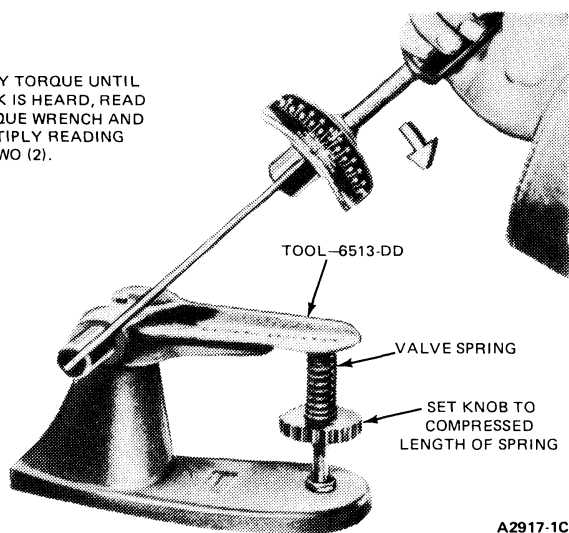


FIG. 34 Checking Valve Spring Pressure

VALVE SPRING SQUARENESS

Check each spring for squareness using a steel square and a surface plate (Fig. 35). Stand the spring and square on end on the surface plate. Slide the spring up to the square. Rotate the spring slowly and observe the space between the top coil of the spring and square. If the spring is out of square more than $5/64$ inch, replace it.

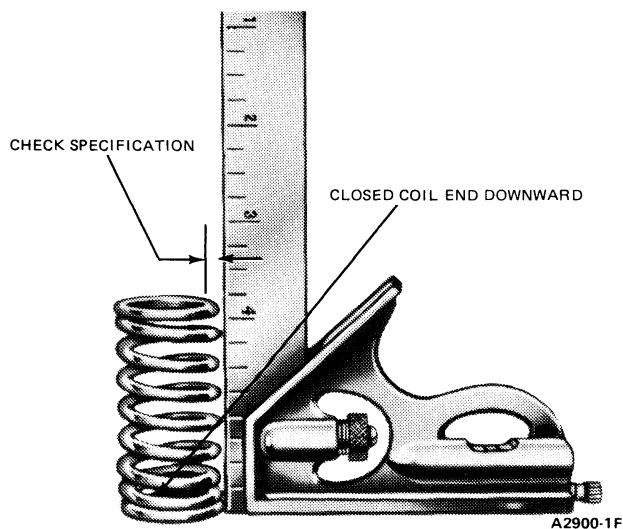


FIG. 35 Checking Valve Spring Squareness

Follow the same procedure to check new valve springs before installation.

Make certain the proper spring (color coded) is installed.

INTAKE MANIFOLD

Cleaning

Remove all gasket material from the machined surfaces of the manifold. Clean the manifold in a suitable solvent and dry it with compressed air.

Inspection

Inspect the manifold for cracks, nicked gasket surfaces, or other damage that would make it unfit for further service. Replace all studs that are stripped or otherwise damaged. **Remove all filings and foreign matter that may have entered the manifold as a result of repairs.**

EXHAUST MANIFOLDS

Cleaning

Remove all gasket material from the manifold(s).

Inspection

On the 4.9L (300 CID) I-6 LD six engine, check the exhaust control valve for freedom from binding throughout the valve travel. If necessary, free the shaft with exhaust control valve solvent. If the solvent does not eliminate the binding condition, replace the component parts. Refer to Exhaust Control Valve Replacement—4.9L (300 CID) I-6 LD Six.

Inspect the manifold(s) for cracks, damaged gasket surfaces, or other damage that would make them unfit for further service. Inspect the cylinder head joining flanges of the exhaust manifold(s) for evidence of exhaust gas leaks.

HYDRAULIC VALVE TAPPETS

The valve tappet assemblies should be kept in proper sequence so that they can be installed in their original position. Inspect and test each tappet separately so as not to intermix the internal parts. **If any part of the tappet assembly needs replacing, replace the entire assembly.**

Cleaning

Thoroughly clean all the parts in clean solvent and wipe them with a clean, lint-free cloth.

Inspection

Inspect the parts and discard the entire tappet assembly if any part shows pitting, scoring, galling or evidence of non-rotation. Replace the entire assembly if the plunger is not free in the body. The plunger should drop to the bottom of the body by its own weight when assembled dry.

Assemble the tappet assembly and check for freeness of operation by pressing down on the push rod cup. The tappets can also be checked with a hydraulic tester to test the leak-down rate. Follow the instructions of the test unit manufacturer or the procedure in this Part.

CAMSHAFT

Clean the camshaft in solvent and wipe it dry. Inspect the camshaft lobes for scoring and signs of abnormal wear. Lobe wear characteristics may result in pitting in the general area of the lobe toe. This pitting is not detrimental to the operation of the camshaft; therefore, the camshaft should not be replaced unless the camshaft lobe lift loss has exceeded specifications.

The lift of camshaft lobes can be checked with the camshaft installed in the engine or on centers. Refer to

Camshaft Lobe Lift under Diagnosis and Testing in this Part.

Replace the camshaft if the distributor drive gear is broken or has chipped teeth.

Check the fuel pump eccentric (if so equipped) for excessive wear.

TIMING CHAIN AND SPROCKETS

Cleaning

Clean all parts in solvent and dry them with compressed air.

Lubricate the timing chain with engine oil before installing it on the engine.

Inspection

Inspect the chain for broken links. Inspect the sprockets for cracks and worn or damaged teeth. Replace all the components of the timing chain and sprocket assembly, if any one item needs replacement.

Inspect the fuel pump drive eccentric assembly for scores, nicks and excessive wear. If the eccentric is scored, replace it.

TIMING GEARS

Cleaning

Clean the gears in solvent and dry them with compressed air.

Inspection

Inspect the gear teeth for scores, nicks, etc. Note the condition of the teeth contact pattern. If the teeth are scored, replace the gears.

It is not necessary to replace the gears in sets. Replace the camshaft gear and check the backlash, runout, etc., to determine if the crankshaft gear should be replaced.

CRANKSHAFT VIBRATION DAMPER AND SLEEVE

Cleaning

Clean the oil seal contact surface on the crankshaft damper or sleeve with solvent to remove any corrosion, sludge or varnish deposits. Excess deposits that are not readily removed with solvent may be removed with crocus cloth. Use crocus cloth to remove any sharp edges, burrs or other imperfections which might damage the oil seal during installation or cause premature seal wear. **Do not use crocus cloth to the extent that the seal surface becomes polished. A finely polished surface may produce poor sealing or cause premature seal wear.**

Inspection

Inspect the crankshaft damper or sleeve oil seal surface for nicks, sharp edges or burrs that might damage the oil seal during installation or cause premature seal wear.

CRANKSHAFT

Cleaning

Handle the crankshaft with care to avoid possible fractures or damage to the finish surfaces. Clean the crankshaft with solvent, and blow out all oil passages with compressed air.

On a 4.9L (300 CID) I-6, Six, clean the oil seal contact surface at the rear of the crankshaft with solvent to remove any corrosion, sludge or varnish deposits. Excess deposits that are not readily removed with solvent may be removed with crocus cloth. Use crocus cloth to remove any sharp edges, burrs or other imperfections which might damage the oil seal during installation or cause premature seal wear. **Do not use crocus cloth to the extent that the seal surfaces become polished. A finely polished surface may produce poor sealing or cause premature seal wear.**

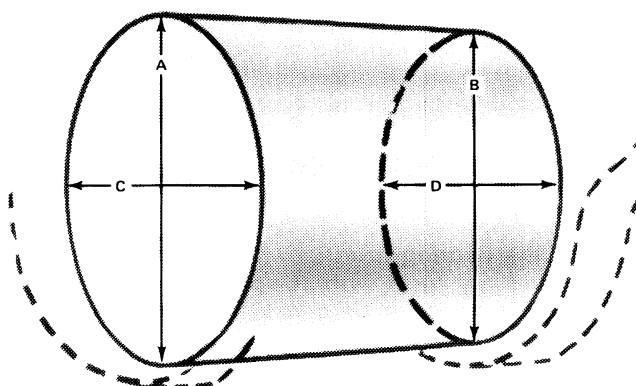
Inspection

Inspect the main and connecting rod journals for cracks, scratches, grooves or scores.

Measure the diameter of each journal at least four places to determine out-of-round, taper or undersize condition (Fig. 36).

A VS B = VERTICAL TAPER
C VS D = HORIZONTAL TAPER
A VS C AND B VS D = OUT OF ROUND

CHECK FOR OUT-OF-ROUND AT EACH END OF JOURNAL



A2901-1B

FIG. 36 Crankshaft Journal Measurement

On an engine used with a manual shift transmission, check the fit of the clutch pilot bearing in the bore of the crankshaft. A needle roller bearing and adapter assembly is used as a clutch pilot bearing on E-100—E-350, F-100—F-350, and Bronco vehicles. It is inserted directly into the engine crank shaft. The bearing and adapter assembly cannot be serviced separately. The needle bearing clutch pilot can only be installed with the seal end of the bearing facing the transmission. The bearing and seal are pre-greased and do not require additional lubrication. A new bearing must be installed whenever a bearing is removed.

Inspect the pilot bearing, when used, for roughness, evidence of overheating or loss of lubricant. Replace if any of these conditions are found.

On the 4.9L (300 CID) I-6 engines, inspect the rear oil seal surface of the crankshaft for excessively deep grooves, nicks, burrs, porosity, or scratches which could damage the oil seal lip during installation. Remove all nicks and burrs and polish the chamfered edge and oil seal contact surface with crocus cloth.

FLYWHEEL

AUTOMATIC TRANSMISSION

Inspection

Inspect the flywheel for cracks or other damage that would make it unfit for further service. Inspect the starter ring gear for worn, chipped or cracked teeth. If the teeth are damaged, replace the flywheel assembly.

With the flywheel installed on the crankshaft, check the gear face runout of the flywheel (refer to Diagnosis and Testing for the proper procedure).

FLYWHEEL

MANUAL-SHIFT TRANSMISSION

Inspection

Inspect the flywheel for cracks, heat checks, or other damage that would make it unfit for further service. Machine the friction surface of the flywheel if it is scored or worn. If it is necessary to remove more than 0.045 inch of stock from the original thickness, replace the flywheel.

Inspect the ring gear for worn, chipped, or cracked teeth. If the teeth are damaged, replace the ring gear.

With the flywheel installed on the crankshaft, check the flywheel face runout, following the procedure under Diagnosis and Testing in this Part.

MAIN AND CONNECTING ROD BEARING

Cleaning

Clean the bearing inserts and caps thoroughly in solvent, and dry them with compressed air. **Do not scrape gum or varnish deposits from bearing shells.**

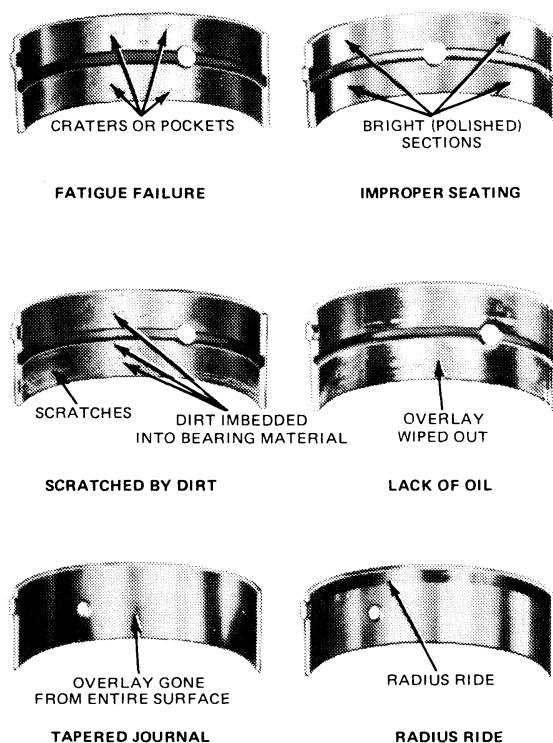
Inspection

Inspect each bearing carefully. Bearings that have a scored, chipped, or worn surface should be replaced. Typical examples of bearings that should be replaced and the causes are shown in Fig. 38. The copper-lead bearing base may be visible through the bearing overlay. This does not mean that the bearing is worn. **It is not necessary to replace the bearing if the bearing clearance is within recommended limits.** Check the clearance of bearings that appear to be satisfactory with Plastigage or it's equivalent. Fit new bearings following the recommended procedure in this Part.

CONNECTING RODS

Cleaning

Remove the bearings from the rod and cap. Identify the bearing if they are to be used again. Clean the connecting rod in solvent, including the rod bore and



A2903-1A

FIG. 37 Typical Bearing Failures

the back of the inserts. **Do not use a caustic cleaning solution. Blow out all passages with compressed air.**

Inspection

The connecting rods and related parts should be carefully inspected and checked for conformance to specifications. Various forms of engine wear caused by these parts can be readily identified.

A shiny surface on the pin boss side of the piston usually indicates that a connecting rod is bent or the piston pin hole is not in proper relation to the piston skirt and ring grooves.

Abnormal connecting rod bearing wear can be caused by either a bent connecting rod, an improperly machined journal, or a tapered connecting rod bore.

Twisted connecting rods will not create an easily identifiable wear pattern, but badly twisted rods will disturb the action of the entire piston, rings, and connecting rod assembly and may be the cause of excessive oil consumption.

Inspect the connecting rods for signs of fractures and the bearing bores for out-of-round and taper. If the bore exceeds the maximum limit and/or if the rod is fractured, it should be replaced.

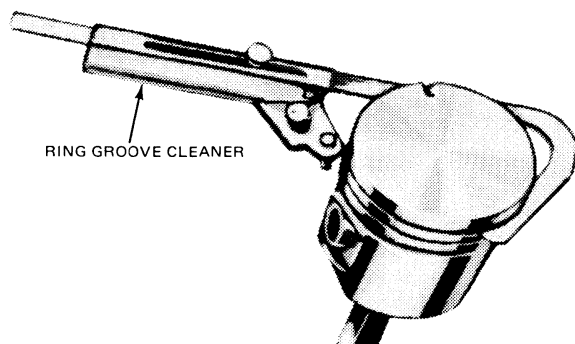
Check the ID of the connecting rod piston pin bore. Install oversize piston pin if the pin bore is not within specifications. Replace worn or damaged connecting rod nuts and bolts.

After the connecting rods are assembled to the piston, check the rods for bends or twists on a suitable alignment fixture. Follow the instructions of the fixture

manufacturer. If the bend and/or twist exceeds specifications, the rod must be straightened or replaced.

PISTONS, PINS AND RINGS

Remove deposits from the piston surfaces. Clean gum or varnish from the piston skirt, piston pins and rings with solvent. **Do not use a caustic cleaning solution or a wire brush to clean pistons.** Clean the ring groove with a ring groove cleaner (Fig. 38). Make sure the oil ring slots (or holes) are clean.



A2918-1B

FIG. 38 Cleaning Ring Grooves—Typical

Inspection

Carefully inspect the pistons for fractures at the ring lands, skirts, and pin bosses, and for scuffed, rough, or scored skirts. If the lower inner portion of the ring grooves have high steps, replace the piston. The step will interfere with ring operation and cause excessive ring side clearance.

Spongy, eroded areas near the edge of the piston top are usually caused by detonation or pre-ignition. A shiny surface on the thrust surface of the piston, offset from the centerline between the piston pin holes, can be caused by a bent connecting rod. Replace pistons that show signs of excessive wear, wavy ring lands or fractures, or damage from detonation or pre-ignition.

Check the piston to cylinder bore clearance by measuring the piston and bore diameters. Refer to the specifications for the proper clearance. Refer to Cylinder Block Inspection in this Part for the bore measurement procedure. **Measure the OD of the piston with micrometers at the centerline of the piston bore and at 90 degrees to the pin bore axis. Check the ring side clearance following the procedure under Fitting Piston Rings in this Part.**

Replace piston pins showing signs of fracture, etching or wear. Check the piston pin fit in the piston and rod. Refer to Pistons and Connecting Rods Assembly, in the pertinent engine Part.

Check the OD of the piston pin and the ID of the pin bore in the piston. Replace any piston pin or piston that is not within specifications.

Replace all rings that are scored, chipped or cracked. Check the end gap and side clearance. It is good practice to always install new rings when overhauling an engine. Rings should not be transferred from one piston to another regardless of mileage.

CYLINDER BLOCK

Cleaning

After any cylinder bore repair operation, such as honing or deglazing, clean the bore(s) with soap or detergent and water. **Then, thoroughly rinse the bore(s) with clean water to remove the soap or detergent, and wipe the bore(s) dry with a clean, lint-free cloth. Finally, wipe the bore(s) with a clean cloth dipped in engine oil. If these procedures are not followed, rusting of the cylinder bore(s) may occur.**

If the engine is disassembled, thoroughly clean the block in solvent. Remove old gasket material from all machined surfaces. Remove all pipe plugs that seal oil passages; then clean out all the passages. Blow out all passages, bolt holes, etc., with compressed air.

Make sure the threads in the cylinder head bolt holes are clean. Dirt in the threads may cause binding and result in a false torque reading. Use a tap to true-up threads and to remove any deposits.

Inspection

After the block has been thoroughly cleaned, check it for cracks. Minute cracks not visible to the naked eye may be detected by coating the suspected area with a mixture of 25 percent kerosene and 75 percent light engine oil. Wipe the part dry and immediately apply a coating of zinc oxide dissolved in wood alcohol. If cracks are present, the coating will become discolored at the cracked area. Replace the block if it is cracked.

Check all machined gasket surfaces for burrs, nicks, scratches and scores. Remove minor imperfections with an oil stone. Check the cylinder block for flatness of the cylinder head gasket surface following the procedure and specifications recommended for the cylinder head. The cylinder block can be machined to bring the cylinder head gasket surface within the flatness specifications, **but not to exceed 0.010 inch stock removal from the original gasket surface.**

Replace all expansion-type plugs that show evidence of leakage.

Inspect the cylinder walls for scoring, roughness, or other signs of wear. Check the cylinder bore for out-of-round and taper. Measure the bore with an accurate bore gauge following the instructions of the manufacturer. Measure the diameter of each cylinder bore at the top, middle and bottom with the gauge placed at right angles and parallel to the centerline of the engine (Fig. 26). Use only the measurements obtained at 90 degrees to the engine centerline when calculating the piston to cylinder bore clearance.

Refinish cylinders that are deeply scored and/or when out-of-round and/or taper exceed the service limits.

If the cylinder walls have minor surface damage, but the out-of-round and taper are within limits, it may be possible to remove such damage by honing the cylinder walls and installing new service piston rings providing the piston clearance is within specified limits.

To remove the cylinder wall glaze or to refinish a cylinder bore, follow the honing procedure described

under Cylinder Block-Refinishing Cylinder Walls in this Part.

OIL PAN

Cleaning

Scrape any dirt or metal particles from the inside of the pan. Scrape all old gasket material from the gasket surface. Wash the pan in a solvent and dry it thoroughly. Be sure all foreign particles are removed from below the baffle plate.

Inspection

Check the pan for cracks, holes, damaged drain plug threads, and a loose baffle. Check the gasket surface for damage caused by over-tightened bolts. Straighten the surface as required to restore original flatness.

Replace the pan if repairs cannot be made.

OIL PUMP

Cleaning

Wash all parts in a solvent and dry them thoroughly with compressed air. Use a brush to clean the inside of the pump housing and the pressure relief valve chamber. Be sure all dirt and metal particles are removed.

Inspection

Refer to the specifications for clearances and service limits.

Check the inside of the pump housing and the outer race and rotor for damage or excessive wear or scoring.

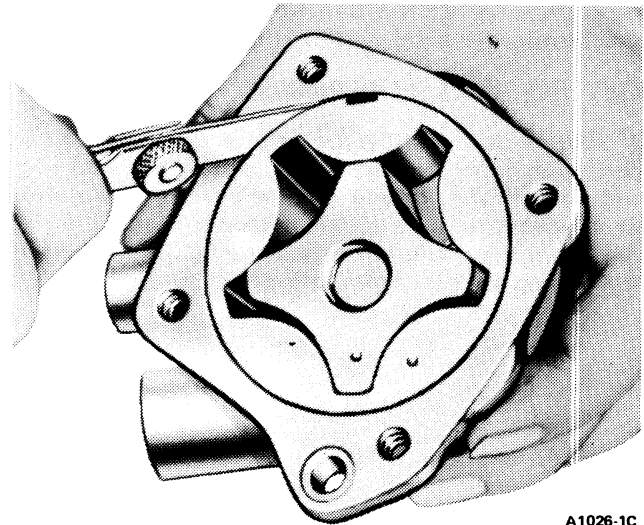
Check the mating surface of the pump cover for wear. If the cover mating surface is worn, scored or grooved, replace the pump.

Measure the outer race to housing clearance (Fig. 39).

With the rotor assembly installed in the housing, place a straight edge over the rotor assembly and the housing. Measure the clearance (rotor end play) between the straight edge and the rotor and outer race (Fig. 40).

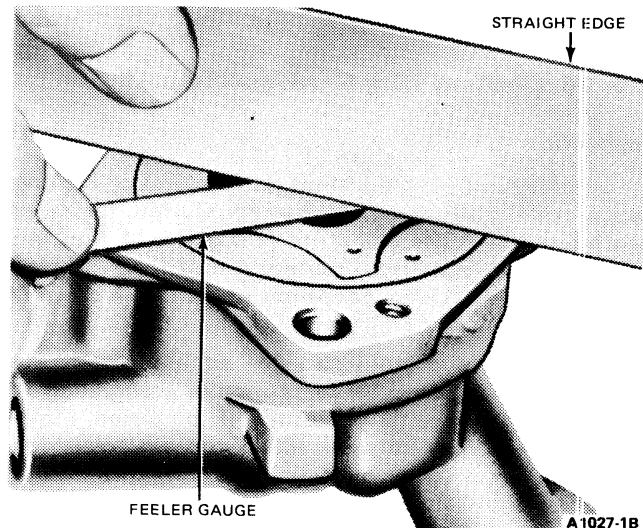
Check the drive shaft to housing bearing clearance by measuring the OD of the shaft and the ID of the housing bearing.

Detail components of the oil pump are not serviced. If any part of the oil pump requires replacement, replace the complete pump assembly.



A1026-1C

FIG. 39 Checking Outer Race-to-Housing Clearance



A1027-1B

FIG. 40 Checking Rotor End Play

Inspect the relief valve spring for a collapsed or worn condition. Check the relief valve spring tension.

Check the relief valve piston for scores and free operation in the bore.

4.9L (300 CID) Six-Cylinder Engine

PART 21-11

SUBJECT	PAGE	SUBJECT	PAGE
ADJUSTMENTS		REMOVAL AND INSTALLATION (Cont'd.)	
Valve Clearance	21-11-7	Crankshaft Ventilation System	21-11-12
CLEANING AND INSPECTION	21-11-34	Cylinder Front Cover and	
DESCRIPTION		Front Oil Seal	21-11-17
Crankcase Ventilation System	21-11-1	Cylinder Head	21-11-16
Engine	21-11-1	Engine Assembly	21-11-9
Exhaust Emission Control System	21-11-1	Engine Front Supports	21-11-11
DIAGNOSIS AND TESTING	21-11-6	Engine Rear Supports	21-11-11
DISASSEMBLY AND ASSEMBLY		Flywheel	21-11-23
Cylinder Assembly — 6009	21-11-34	Main Bearing	21-11-25
Cylinder Block — 6010	21-11-33	Manifolds	21-11-17
Cylinder Head	21-11-31	Oil Filter	21-11-30
Piston and Connecting Rod	21-11-32	Oil Pan	21-11-19
Valve Lifter	21-11-32	Oil Pump	21-11-20
REMOVAL AND INSTALLATION		Pistons and Connecting Rods	21-11-27
Camshaft	21-11-21	Timing Gears	21-11-22
Camshaft Bearings	21-11-30	Valve Lifter	21-11-15
Camshaft Rear Bearing		Valve Rocker Arm Cover and	
Bore Plug	21-11-24	Rocker Arm	21-11-13
Clutch Pilot Bearings	21-11-23	Valve Spring, Retainer and	
Connecting Rod Bearing	21-11-26	Stem Seal	21-11-14
Crankshaft	21-11-28	Water Pump	21-11-17
Crankshaft Rear Oil Seal	21-11-24	SPECIFICATIONS	21-11-35

DESCRIPTION

ENGINE

The 4.9L (300 CID) I-6 engine block is a special high grade cast iron. The crankshaft has seven (7) main bearings. The 4.9L (300 CID) I-6 crankshaft is precision cast nodular iron. Pistons are aluminum alloy with integral steel struts. The valve rocker arms are ball pivot stud mounted. Positive Stop Rocker Arms Studs are used. Tappets are hydraulic, self-adjusting. The 4.9L (300 CID) I-6 engine has exhaust valve rotators. Timing gears are helical gear type.

The 4.9L (300 CID) I-6 is the standard engine for E100-E350, Bronco, F100-F350, F150-F250 4x4 Series. The 4.9L (300 CID) I-6 is available for Canadian leaded fuel applications.

The illustrations shown in Figs. 1 and 2 are typical and will serve as a reference for the procedures

outlined. The numbers and part descriptions shown in the illustration keys are basic part numbers corresponding with the Ford Master Parts Catalog.

Refer to the end of the chapter for all specifications and belt torques.

EXHAUST EMISSION CONTROL SYSTEM

The exhaust emission control devices used on these engines are covered in Group 29 of this Manual.

CRANKCASE VENTILATION SYSTEM

These engines are equipped with a positive, closed type ventilation system which directs the crankcase vapors to the intake manifold for combustion.

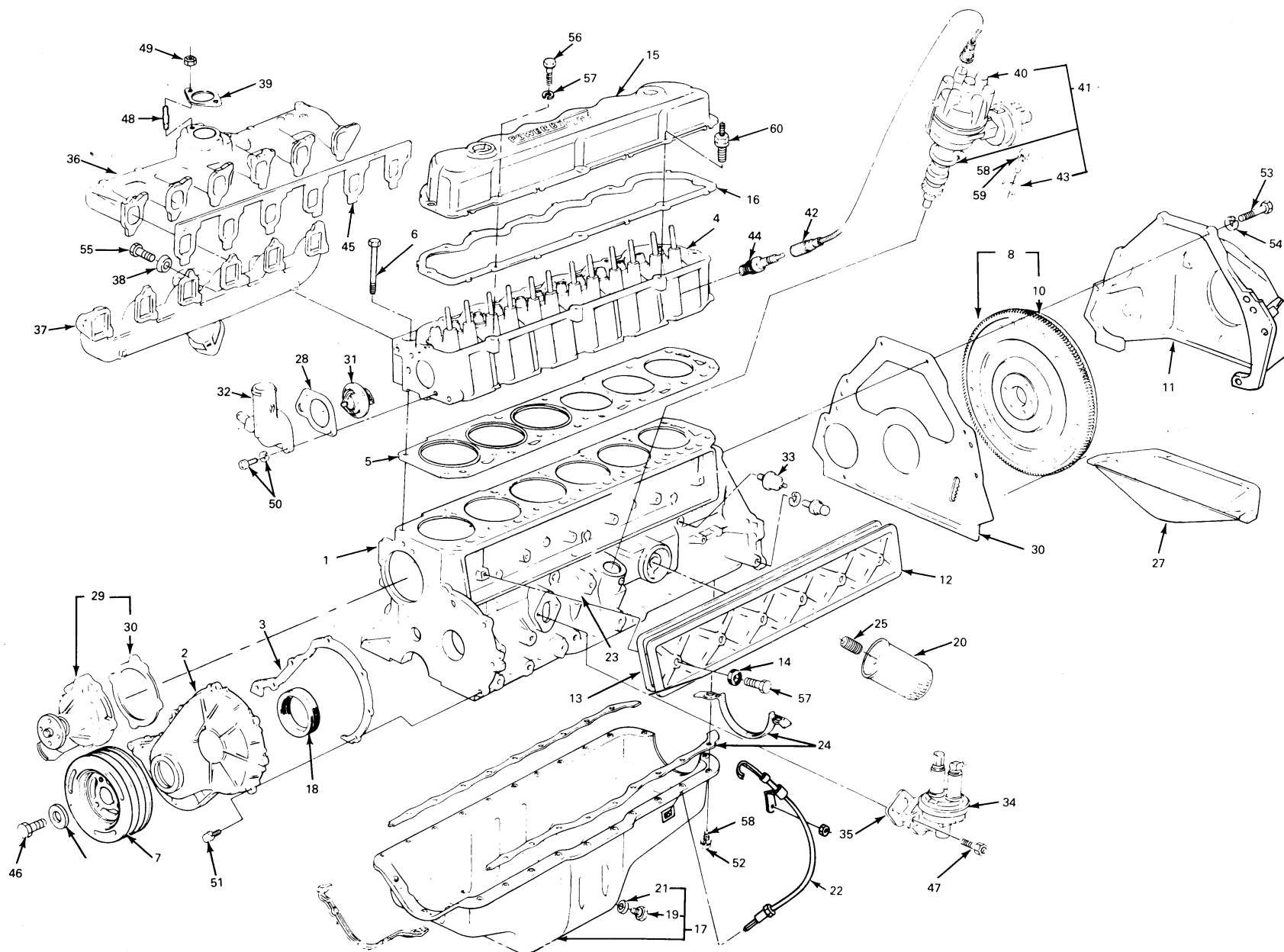


FIG. 1 External Exploded View—4.9L (300 CID) I-6 Engine

A4962-2A

REF. NO.	BASIC PART NO.	DESCRIPTION	REF. NO.	BASIC PART NO.	DESCRIPTION	REF. NO.	BASIC PART NO.	DESCRIPTION
1	6009	Cylinder Assy. (Includes internal parts)	25	6890	Insert — Oil Filter Mounting Bolt	50	376256-S	Bolt — Washer Head — 5/16-18 x 1"
2	6019	Cover Assy. — Cylinder Front	26	7007	Plate Assy. — Engine Rear	51	382781-S	Bolt — Washer Head — 5/16-18 x 7/8"
3	6020	Gasket — Cylinder Front Cover	27	7564	Cover — Clutch Housing Dust	52	20326-S	Bolt — 5/16-18 x 5/8"
4	6049	Head — Cylinder	28	8255	Gasket — Water Outlet Connection	53	20508-S	Bolt — 7/16-14 x 1-3/4"
5	6051	Gasket — Cylinder Head	29	8501	Pump Assy. — Water	54	34808-S	Washer — Lock — 7/16-25/32 x 7/64"
6	6065	Bolt — Cylinder Head	30	8507	Gasket — Water Pump Housing	55	359088-S	Bolt — 3/8-16 x 1-1/4"
7	6312	Pulley Assy. — Crankshaft (includes damper)	31	8575	Thermostat	56	20324-S	Bolt — 1/4-20 x 5/8"
8	6375	Flywheel Assy.	32	8592	Connection — Water Outlet	57	34805-S	Washer — Lock — 1/4-1/2 x 1/16"
9	6378	Washer — Crankshaft Pulley Retaining	33	9278	Gauge Assy. — Oil Pressure Engine Unit	58	20386-S	Bolt — 5/16-18 x 1"
10	6384	Gear — Flywheel Ring	34	9350	Pump Assy. — Fuel	59	34806-S	Washer — Lock — 5/16-19/32 x 5/64"
11	6392	Housing Assy. — Flywheel	35	9417	Gasket — Fuel Pump Mounting	60	384817-S	Stud and Washer
12	6519	Cover — Valve Push Rod	36	9424	Manifold — Intake			
13	6521	Gasket — Valve Push Rod Cover	37	9430	Manifold — Exhaust			
14	6570	Grommet — Valve Push Rod Cover Bolt	38	9433	Gasket Set — Manifold			
15	6582	Cover Assy. — Valve Rocker Arm	39	9447	Gasket — Carburetor			
16	6584	Gasket — Valve Rocker Cover	40	12106	Cap — Distributor			
17	6675	Pan Assy. — Oil	41	12127	Distributor Assy.			
18	6700	Seal — Cylinder Front Cover	42	12259	Wire Set — Spark Plug			
19	6730	Plug — Oil Pan Drain	43	12270	Hold Down — Distributor			
20	6731	Element Assy. — Oil Filter	44	12405	Spark Plug Assy.			
21	6734	Gasket — Oil Pan Drain Plug	45	9461	Gasket — Intake Manifold to Cylinder Head			
22	6750	Indicator — Oil Level	46	377850-S	Bolt — 5/8-18 x 2"			
23	6754	Tube Assy. — Oil Level Indicator	47	358805-S	Screw and Washer Assy. — 5/16-18 x 1-1/4"			
24	6781	Gasket Set — Oil Pan	48	88392-S	Stud Screw — Carburetor to Manifold			
			49	33925-S	Nut — Hexagon Jam 3/8-24"			

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FIG. 1 External Exploded View—Key

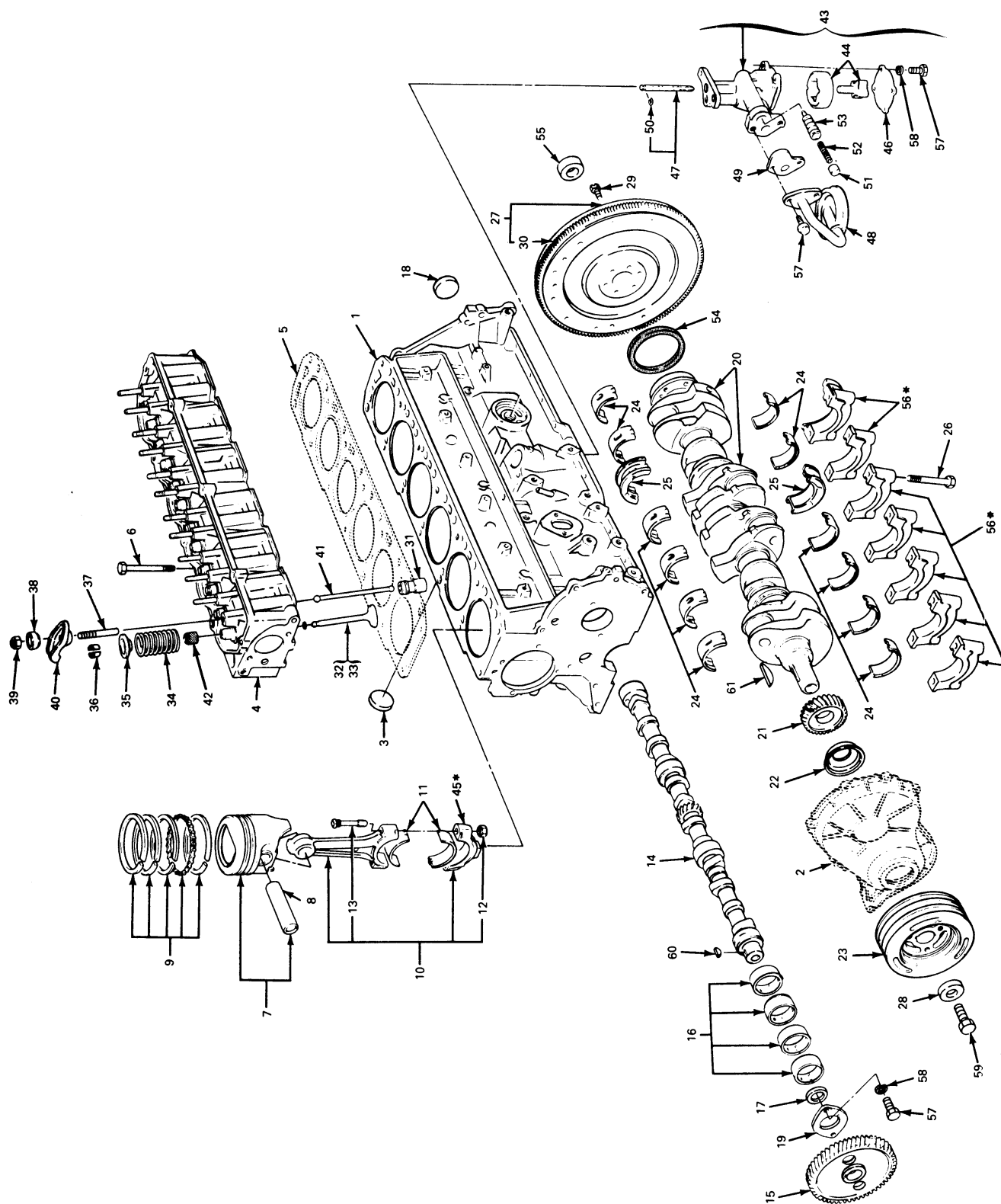


FIG. 2 Internal Exploded View—4.9L (300 CID) I-6 Engine

REF. NO.	BASIC PART NO.	DESCRIPTION	REF. NO.	BASIC PART NO.	DESCRIPTION	REF. NO.	BASIC PART NO.	DESCRIPTION
1	6010	Block Assy. (Internal parts not included)	37	6A527	Stud — Valve Rocker Arm Support			
2	6019	Cover Assy. — Cylinder Front	38	6A528	Seat — Valve Rocker Arm Fulcrum			
3	6026	Plug — Engine	39	6A529	Nut — Valve Rocker Arm Stud			
4	6049	Head — Cylinder	40	6564	Arm — Valve Rocker			
5	6051	Gasket — Cylinder Head	41	6565	Rod — Valve Push			
6	6065	Bolt — Cylinder Head	42	6571	Seal — Valve Stem (I and E)			
7	6108	Piston Assy.	43	6600	Pump Assy — Oil			
8	6135	Pin — Piston	44	6608	Rotor and Shaft Assy. — Oil Pump Drive			
9	6148	Ring Set — Piston						
10	6200	Rod Assy. — Connecting	45	*	Rod Cap — Supplied with 6200 Rod Assy.			
11	6211	Bearing — Connecting Rod						
12	6212	Nut — Connecting Rod	46	6616	Plate — Oil Pump Drive			
13	6214	Bolt — Connecting Rod	47	6A618	Shaft Assy. — Oil Pump Intermediate			
14	6250	Camshaft	48	6622	Screen, Tube and Cover Assy. — Oil Pump			
15	6256	Gear — Camshaft	49	6626	Gasket — Oil Pump Inlet Tube			
16	6262	Bearing — Camshaft						
17	6265	Spacer — Camshaft Gear	50	6629	Ring — Oil Pump Intermediate Shaft			
18	6266	Plug — Camshaft Rear Bearing	51	6666	Plug — Oil Pump Relief Valve			
19	6269	Plate — Camshaft Thrust	52	6670	Spring — Oil Pump Relief Valve			
20	6303	Crankshaft Assy.	53	6674	Plunger — Oil Pump Relief Valve			
21	6306	Gear — Crankshaft	54	6701	Packing — Crankshaft Rear			
22	6310	Slinger — Crankshaft Oil	55	7600	Bearing — Clutch Pilot			
23	6312	Pulley Assy. — Crankshaft (includes damper)	56	*	Main Bearing Cap — Supplied in 6010 Block Assy.			
24	6333	Bearing — Crankshaft Main	57	20346-S8	Bolt — 5/16-18 x 3/4"			
25	6337	Bearing — Crankshaft Main (thrust)	58	34806-S	Washer — Lock — 5/16-19/32 x 5/64"			
26	6345	Bolt — Crankshaft Main Bearing Cap	59	377850-S	Bolt — 5/8-18 x 2"			
27	6375	Flywheel Assy.	60	74147-S	Key, Woodruff — 3/4 x 5/32"			
28	6378	Washer — Crankshaft Pulley Retaining	61	379153-S	Key, Woodruff — 3/16 x 1-3/4"			
29	6379	Bolt — Flywheel to Crankshaft						
30	6384	Gear — Flywheel Ring						
31	6500	Tappet Assy. — Valve Hydraulic						
32	6505	Valve — Exhaust						
33	6507	Valve — Intake						
34	6513	Spring — Valve						
35	6514	Retainer — Valve Spring						
36	6518	Key — Valve Spring Retainer						

A4965-2A

FIG. 2 Internal Exploded View—Key

DIAGNOSIS AND TESTING

Refer to Diagnosis and Testing in Part 21-01, General Gasoline Engine Service.

LUBRICATION SYSTEM

Oil from the oil pan sump is forced through the pressure-type lubrication system by a rotor-type oil pump (Fig. 3). A spring-loaded relief valve in the pump limits the maximum pressure of the system. Oil relieved by the valve is directed back to the intake side of the pump.

The engine has a full-flow disposable Rotunda filter or a replaceable element-type filter which filters the entire output of the pump before the oil enters the engine. The filters have an integral relief valve. The relief valve permits oil to by-pass the filter if it becomes clogged, thereby maintaining a continual supply of oil to the engine at all times. An anti-drain back feature is designed into the oil filter system to prevent a reverse flow of oil when the engine is stopped.

From the filter, the oil flows into the main oil gallery. The oil gallery supplies oil to all the camshaft and main bearings.

The crankshaft is drilled from the main bearings to the connecting rod journals to lubricate the rod bearings.

Oil, from the floor of the valve lifter chamber, is fed through a drilled passage in the cylinder block into the distributor pilot to lubricate the distributor shaft, bushings, and the distributor to oil pump intermediate shaft engagement.

The main oil gallery intersects all of the valve lifter bores supplying pressure oil to the hydraulic valve

lifters. A reservoir at each valve lifter bore boss traps oil so that oil is available for valve lifter lubrication as soon as the engine starts.

When the hydraulic lifter is on the base circle of the camshaft lobe (valve closed), the oil hole in the hydraulic lifter is indexed with the oil gallery, and oil flows into the plunger. Oil is also metered through the metering valve (disc) through the oil passages in the push rod cup and it flows up the hollow push rod. In this position, the drilled hole in the ball end of the push rod is indexed with a drilled hole in the rocker arm, and the oil lubricates the upper valve train bearing areas. Excess oil is returned to the oil pan through drain holes along the side of the cylinder head and block.

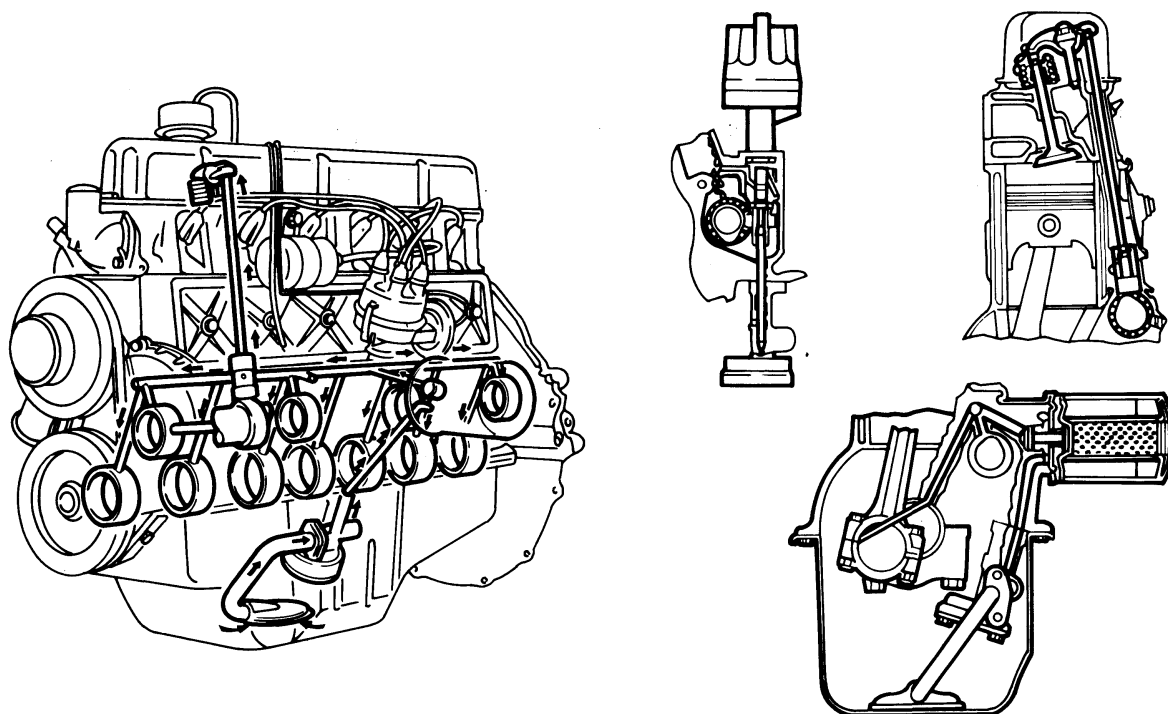
Excess oil in the push rod chamber drains back into the oil pan through openings along the cylinder block.

COOLING SYSTEM

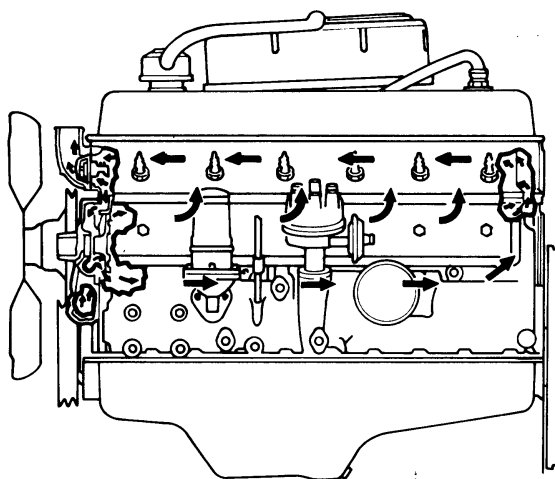
The coolant is drawn from the bottom of the radiator by the water pump, which delivers the coolant to the cylinder block (Fig. 4).

As the coolant enters the block, it travels through cored passages to cool the entire length of each cylinder wall. Upon reaching the rear of the cylinder block, the coolant is directed upward into the cylinder head where it cools the combustion chambers, valves and valve seats on its return to the front of the engine.

The coolant from the cylinder head flows into the coolant outlet housing, past the thermostat if it is open, and into the top of the radiator. If the thermostat is closed, a small portion of the coolant is returned to the water pump for recirculation.



A2176-2B

FIG. 3 Typical Lubrication System

A2274-1A

FIG. 4 Engine Coolant Flow Typical

ADJUSTMENTS

VALVE CLEARANCE

A 0.060 inch shorter push rod or a 0.060 inch longer push rod are available for service to provide a means of compensating for dimensional changes in the valve mechanism. Refer to the Master Parts List or the specifications for the pertinent color code.

Valve stem to valve rocker arm clearance should be within specifications with the hydraulic lifter completely

collapsed. Repeated valve reconditioning operations (valve and/or valve seat refacing) will decrease the clearance to the point that if it is not compensated for, the hydraulic valve lifter will cease to function and the valve will be held closed.

The positive stop rocker arm stud eliminates the necessity of adjusting the valve clearance. However, to obtain the specified valve clearance, it is important that

all valve components be in a serviceable condition and installed and tightened properly.

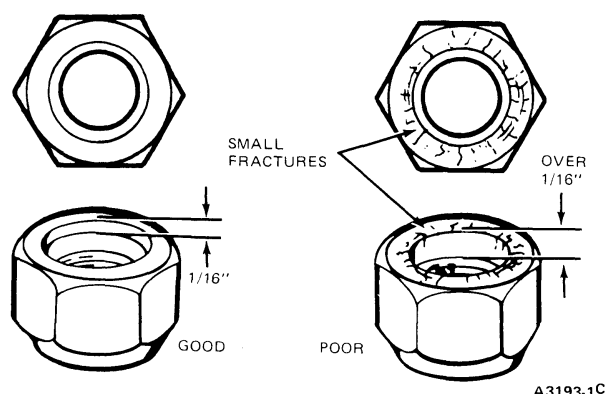


FIG. 5 Inspection of Rocker Arm Stud Nut

With the crankshaft in the positions designated in the following procedure Steps 3, 4 and 5, remove and inspect the stud nut for conditions shown in Fig. 5. Install and turn the stud nut clockwise until it contacts the stop. Tighten the nut to specifications.

To determine whether a shorter or a longer push rod is necessary, make the following check.

1. Install an auxiliary starter switch. **Crank the engine with the ignition switch OFF.**
2. Make two chalk marks on the crankshaft damper (Fig. 6). Space the marks approximately 120 degrees apart so that, with the timing mark, the damper is divided into three equal parts (120 degrees is one-third of the distance around the damper circumference).
3. Rotate the crankshaft until No. 1 piston is on TDC at the end of the compression stroke. **Check the breakaway torque (torque required to turn nut in a counterclockwise direction) of each stud nut.** Replace the stud nut if the breakaway torque does not meet specifications shown at rear of this Part. If, after replacing the stud nut, the breakaway torque still is not within specifications, replace the stud.
4. With No. 1 piston on TDC at the end of the compression stroke, install and tighten the nut to specifications.

Then slowly supply pressure to bleed down the hydraulic lifter until the plunger is completely bottomed (Fig. 7).

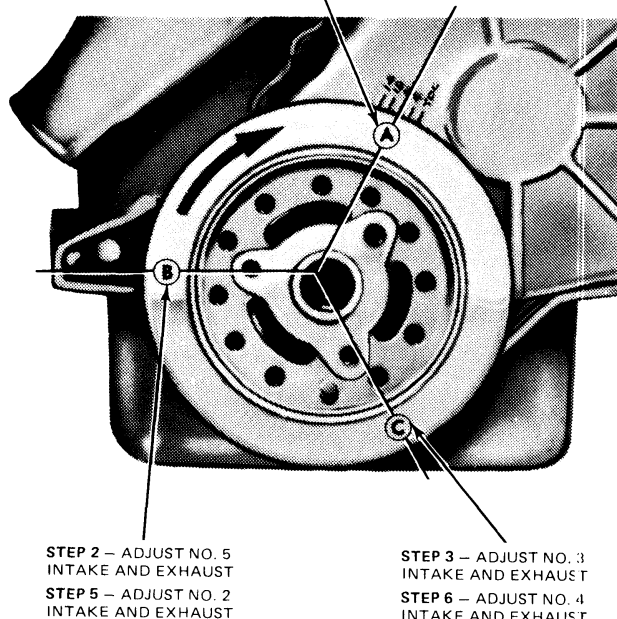
Hold the lifter in this position and check the available clearance between the rocker arm and the valve stem tip with a feeler gauge.

If the clearance is less than specifications, install a shorter push rod.

If the clearance is greater than specifications, install a longer push rod.

STEP 1 — SET NO. 1 PISTON ON T.D.C. AT END OF COMPRESSION STROKE ADJUST NO. 1 INTAKE AND EXHAUST

STEP 4 — ADJUST NO. 6 INTAKE AND EXHAUST



A2925-1A

FIG. 6 4.9L (300 CID) Six Valve Clearance

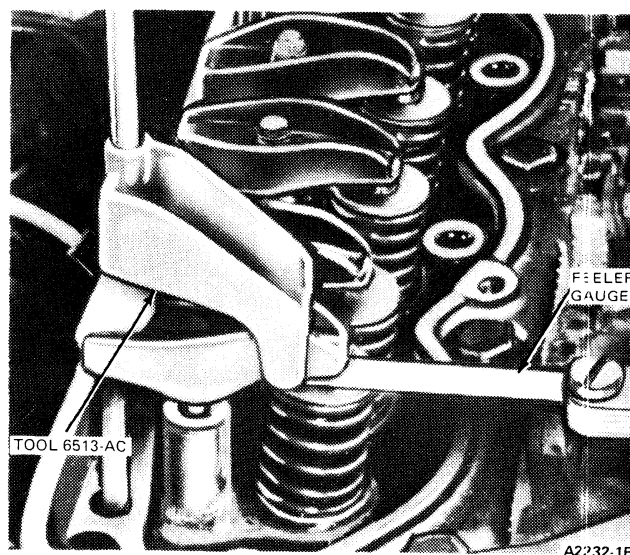


FIG. 7 Valve Clearance Check

5. Repeat this procedure for the remaining set of valves, turning the crankshaft with an auxiliary starter switch, one-third turn at a time, in the direction of rotation, while adjusting the valves in the firing order sequence, 1-5-3-6-2-4.

REMOVAL AND INSTALLATION

When installing nuts or bolts that must be tightened, oil the threads with light weight engine oil. **Do not oil**

threads that require oil-resistant or water-resistant sealer.

Refer to Part 21-01 for Repair and Cleaning and Inspection procedures.

ENGINE ASSEMBLY

F-100—F-350 and Bronco

The engine removal and installation procedures are for the engine only without the transmission attached.

Removal

1. Drain the cooling system and the crankcase. Remove the hood. Remove the air cleaner. Remove air conditioner compressor and condenser as described in Group 36.
2. Disconnect the battery ground cable. Disconnect the heater hose from the water pump and coolant outlet housing. Disconnect the flexible fuel line from the fuel pump.
3. Remove the radiator following the procedures in Group 27.
4. Remove the cooling fan, spacer, water pump pulley and fan drive belt (F-100—F350 shown in Fig. 8).

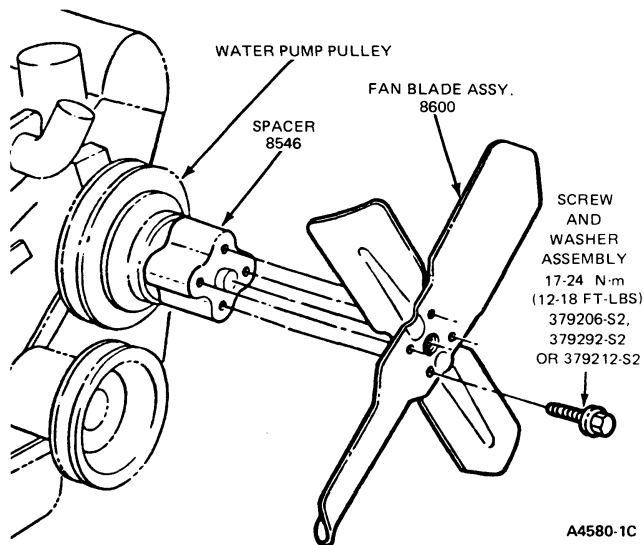


FIG. 8 Fan Blade Installation F-100—F-350

5. Disconnect the accelerator cable and the choke cable at the carburetor. Remove the cable retracting spring.
On a vehicle with power brakes, disconnect the vacuum line at the intake manifold.
On a vehicle with an automatic transmission, disconnect the transmission kickdown rod at the bellcrank assembly.
6. Disconnect the exhaust manifold from the muffler inlet pipe. Disconnect the body ground strap and the battery ground cable at the engine.
7. Disconnect the engine wiring harness at the ignition coil, coolant temperature sending unit and oil pressure sending unit. Position the harness out of the way.
8. Remove the alternator mounting bolts and position the alternator out of the way, leaving the wires attached.

On a vehicle with power steering, remove the power steering pump from the mounting brackets and position it right side up and to one side, leaving the lines attached. If equipped with an air compressor, bleed the air system and disconnect the two air pressure lines at the compressor.

9. Raise the vehicle. Remove the starter (and the automatic transmission fluid filler tube bracket). Remove the engine rear plate upper right bolt.

On a vehicle with a manual-shift transmission, remove all the flywheel housing lower attaching bolts. Disconnect the clutch retracting spring.

On a vehicle with an automatic transmission, remove the converter housing access cover assembly. Remove the flywheel to converter nuts and secure the converter assembly in the housing. Remove the transmission oil cooler lines from the retaining clip at the engine. Remove the converter housing to engine lower attaching bolts.

10. On F-100—F-350, remove the insulator to intermediate support bracket nut from each engine front support.
11. Lower the vehicle and position a transmission jack under the transmission to support it. Remove the remaining flywheel or converter housing to engine bolts.
12. Attach the engine lifting sling. Raise the engine slightly and carefully pull it from the transmission. Lift the engine out of the chassis.

Installation

1. Place a new gasket on the muffler inlet pipe.
2. Lower the engine carefully into the chassis. Make sure the dowels in the block engage the holes in the flywheel or converter housing.

On a vehicle with an automatic transmission, start the converter pilot into the crankshaft. Remove the retainer securing the converter in the housing.

On a vehicle with a manual-shift transmission, start the transmission input shaft into the clutch disc. It may be necessary to adjust the position of the transmission with relation to the engine if the transmission input shaft will not enter the clutch disc. **If the engine hangs up after the shaft enters, turn the crankshaft slowly (with the transmission in gear) until the shaft splines mesh with the clutch disc splines.**

3. Install the converter or flywheel housing upper attaching bolts. Remove the jack supporting the transmission.
4. Lower the engine until it rests on the engine support(s) and remove the lifting sling.
5. On F-100—F-350, install the engine left and right support insulator to intermediate support bracket attaching nuts and washers. Tighten the nuts to 55-81 N·m (40-60 ft-lbs). Install the automatic transmission oil cooler lines bracket.
6. Install the remaining converter or flywheel housing attaching bolts. Connect the clutch return spring.
7. Install the starter and connect the starter cable. Attach the automatic transmission fluid filler tube bracket, (if so equipped).

On a vehicle with an automatic transmission, install the transmission oil cooler lines in the bracket at the cylinder block.

8. Install the exhaust manifold to muffler inlet pipe lockwashers and nuts. Tighten the nuts to 34-51 N·m (25-38 ft-lbs).
9. Connect the engine ground strap and the battery ground cable.
10. On a vehicle with an automatic transmission, connect the kickdown rod to the bellcrank assembly on the intake manifold.

Connect the accelerator linkage to the carburetor and install the retracting spring. Connect the choke cable to the carburetor and hand throttle, if so equipped.

On a vehicle with power brakes, connect the brake vacuum line to the intake manifold.

11. Connect the coil primary wire, oil pressure and coolant temperature sending unit wires, flexible fuel line, heater hoses and the battery positive cable.
12. Install the alternator on the mounting bracket.

On a vehicle with power steering, install the power steering pump on the mounting brackets.

13. Install the water pump pulley, spacer, cooling fan and drive belt. Tighten the fan bolts to specifications. See Fig. 8 for F-100—F-350 installation.

Adjust all drive belts tension to Specification. Tighten the alternator, power steering pump and air compressor mounting bolts to Specification (refer to applicable Shop Manual Part).

14. Install the radiator. Connect the radiator lower hose to the water pump and the radiator upper hose to the coolant outlet housing. Connect the air compressor lines. If removed, install air conditioner compressor and condenser.

On a vehicle with an automatic transmission, connect the oil cooler lines.

15. If applicable, install and adjust the hood.
16. Fill and bleed the cooling system (refer to Group 27). Fill the crankcase. Operate the engine at fast idle and check all hose connections and gaskets for leaks.
17. Adjust the carburetor idle speed to Specifications on the Engine Decal.

On a vehicle with standard transmission, adjust the clutch pedal free travel. (Refer to Part 16-03, Mechanical Clutch Linkage.)

On a vehicle with an automatic transmission, adjust the transmission control linkage. (Refer to Part 17-02, Shift Control Linkage.) Check the fluid level and add as required to bring it to the proper level on the oil indicator.

18. Install the air cleaner.

E-100—E-350

Removal

1. Open the hood and door and install seat covers. Then remove the engine cover, drain the coolant, remove the air cleaner and disconnect the battery.

2. Remove the front bumper. Then remove the grille and lower gravel deflector as an assembly.
3. Disconnect the radiator hose at the engine.
4. Remove the lower radiator hose at the radiator.
5. Disconnect the transmission oil cooler lines at the radiator, (if so equipped).
6. Remove the radiator and the shroud, (if so equipped).
7. Disconnect the heater hoses at the engine.
8. Disconnect the alternator and move aside.
9. Remove the power steering pump drive belt. Then remove the power steering pump and support from the engine and move aside.
10. Disconnect the fuel line at the pump and plug it.
11. Disconnect the distributor and sender unit wires from the engine.
12. Disconnect the brake booster hose at the engine.
13. Disconnect the accelerator cable and remove the bracket from the engine.
14. Disconnect the automatic transmission, kickdown at the bell crank.
15. Remove the exhaust manifold heat deflector. Then remove the inlet pipe to manifold nuts.
16. Disconnect both ends of the transmission vacuum line from the intake manifold and junction.
17. Remove the upper transmission to engine bolts.
18. Remove the automatic transmission, dipstick tube support bolt at the intake manifold.
19. Raise the vehicle on the hoist and drain the crankcase.
20. Disconnect the wires from the starter and remove the starter.
21. Remove the flywheel inspection cover.
22. Remove the four converter nuts, then remove the front engine support nuts.
23. Remove the oil filter.
24. Complete the removal of the engine to transmission nuts.
25. Lower the vehicle on the hoist.
26. Install the lift chain and remove the engine from the engine compartment.

Installation

1. Position the engine and lower into place. Then start the mounting bolts.
2. Remove the lifting chain and connect the exhaust inlet to the manifold.
3. Connect the transmission dipstick tube (if so equipped) to the intake manifold.
4. Install the manifold heat shield.
5. Connect the automatic transmission (if so equipped) kick down rod, then install the upper transmission to engine bolts.
6. Connect the transmission vacuum line at the junction.
7. Install the accelerator cable and bracket assembly.
8. Connect the distributor and sender unit wires to the engine.

9. Connect the brake booster hose.
10. Unplug and connect the fuel line to the fuel pump.
11. Connect the transmission vacuum line to the manifold.
12. Reinstall the alternator wires.
13. Connect the heater hoses to the engine.
14. Install the power steering pump and support bracket.
15. Install and adjust the power steering pump belt for the proper tension.
16. Install the radiator and shroud assembly.
17. Position the grille and lower gravel deflector.
18. Connect the upper radiator hose, then install the grille and deflector bolts and screws.
19. Install the bumper, then raise the vehicle on the hoist.
20. Install the converter nuts, then install the flywheel inspection cover bolts.
21. Connect the starter wires and install the starter assembly.
22. Install the oil filter.
23. Install the front support nuts, and the lower engine to transmission bolts and tighten to 89-122 N·m (65-90 ft-lbs) (front support nuts) and 75-88 N·m (55-65 ft-lbs) (rear bolts).
24. Connect the lower radiator hose.
25. Connect the transmission cooler lines to the radiator.
26. Install the alternator splash shield.
27. Lower the vehicle on the hoist.
28. Fill the cooling system, connect the battery and fill the crankcase with the proper grade of oil.
29. Start the engine and check for leaks. Then install the engine cover and close the hood and door.

ENGINE FRONT SUPPORTS

The 4.9L (300 CID) I-6 engine for F-100—F-350, Bronco, E-100—E-350 is mounted on three engine mounts. These models have two front mounts located on each side of the engine and one rear mount located on the transmission extension housing.

The mounts and their applications are shown in Figs. 9 and 10.

E-100—E-350

Removal

1. Raise the vehicle on a hoist.
2. Remove the front support insulator to support bracket nuts and washers from both insulators (Fig. 9).
3. Place a transmission jack under the engine oil pan and position a wood block between the jack and oil pan. Raise the engine just enough to take the weight off the support brackets.
4. The support brackets are mounted to the front frame crossmember with four bolts and locknuts. If these are to be removed, loosen the four lock nuts on each support bracket and remove from the crossmember.

5. Remove the insulator assembly to cylinder block bolts and remove the front support insulator(s).

Installation

1. Install the insulator(s) on the engine block and tighten the bolts to specifications.
2. Install the four bolts and locknuts on the front crossmember support brackets. Tighten to specifications.
3. Lower the engine until the front support insulators engage the support brackets. Remove the transmission jack.
4. Install the front support insulator to support bracket nuts and washers. Tighten the nuts to specifications.
5. Lower the hoist.

DOUBLE FRONT MOUNT F-100—F-350 AND BRONCO

The procedures given apply to either a right or left installation (Fig. 10).

Removal

1. Remove the insulator-to-support bracket nut and washer. **If only one insulator is being removed, loosen the other insulator at support bracket.**
2. Using a jack and a wood block placed under the oil pan, raise the engine to allow just enough clearance for removal of the mount(s).
3. Remove the insulator(s) to engine bolts and lockwashers. Remove the insulator.

Installation

1. Position the insulator on the engine. Install new insulator-to-engine bolts and lockwashers. Tighten to specifications (Fig. 8).
2. Lower the engine carefully to make sure the insulator stud and pin engage the support bracket mounting hole.
3. Install the nut and lockwasher on the insulator stud. Tighten the insulator nut and bolts to specifications.
4. If only one insulator was removed, tighten the other insulator at the support bracket.

ENGINE REAR SUPPORTS

F-100—350 AND BRONCO

Removal

1. Remove the attaching bolts, nut and washers (Fig. 11).
2. Raise the transmission slightly to provide clearance and remove the insulator and insulator retainer.

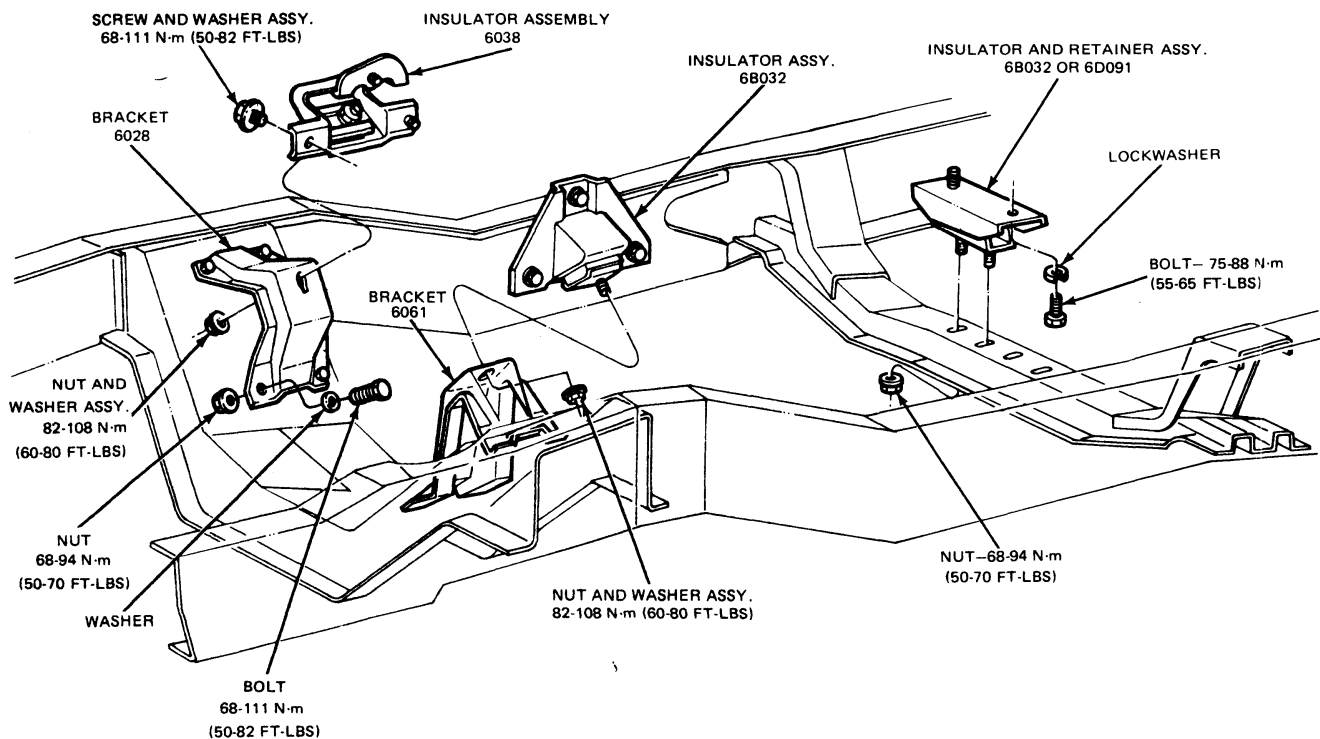
Installation

1. Position the insulator and retainer (Fig. 11).
Install the insulator-to-extension housing, lockwashers and bolts.
2. Lower the transmission and install the insulator-to-frame crossmember bolt. Tighten the nut and bolts to specifications.

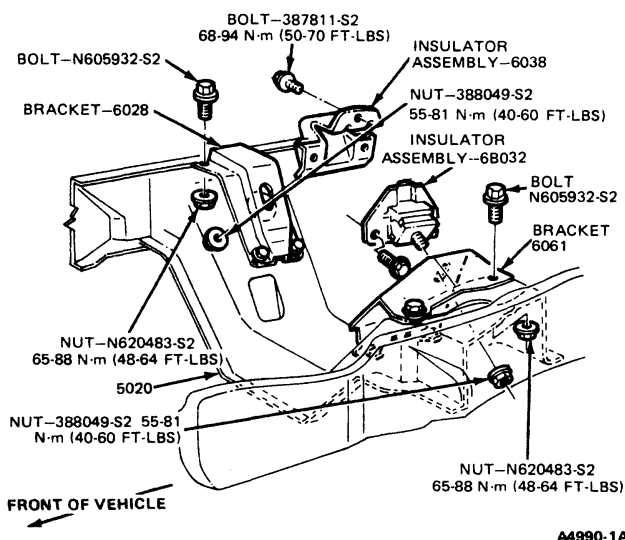
E-100—E-350

Removal

1. Raise the vehicle on a hoist. Place a transmission



A35 14-2F

FIG. 9 Engine Supports—E-100—E-350**FIG. 10 Engine Supports—F-100—F-350 and Bronco**

jack under the transmission and raise it slightly so the transmission weight is not supported by the rear support insulator.

- Remove the insulator to crossmember and transmission extension housing locknuts and bolts (Fig. 9).
- Remove the rear support insulator.

Installation

- Position the rear support insulator between the transmission extension housing and vehicle

crossmember. Refer to Fig. 9 for the proper position of the support insulator.

- Install the support insulator attaching bolts and locknuts. Tighten the locknuts to specifications.
- Lower the transmission and remove the transmission jack. Lower the vehicle.

CRANKCASE VENTILATION SYSTEM

Removal

Refer to Figs. 12 and 13.

- Grasp the crankcase ventilation regulator (PCV) valve and pull upwards to remove it from the rocker arm cover.
- Remove the PCV valve from the vent hoses.
- Remove the air inlet hose from the oil fill cap and carburetor air cleaner.

Installation

- Install the hose on the inlet tube in the intake manifold. Install the PCV valve in the hoses.
- Insert the PCV valve into the rocker arm cover mounting grommet.
- Connect the air inlet hose to the oil fill cap and carburetor air cleaner.
- Operate the engine and check for leaks. **CAUTION: Do not operate the engine with the hood open until the fan has been first examined for possible cracks and blade separation.**

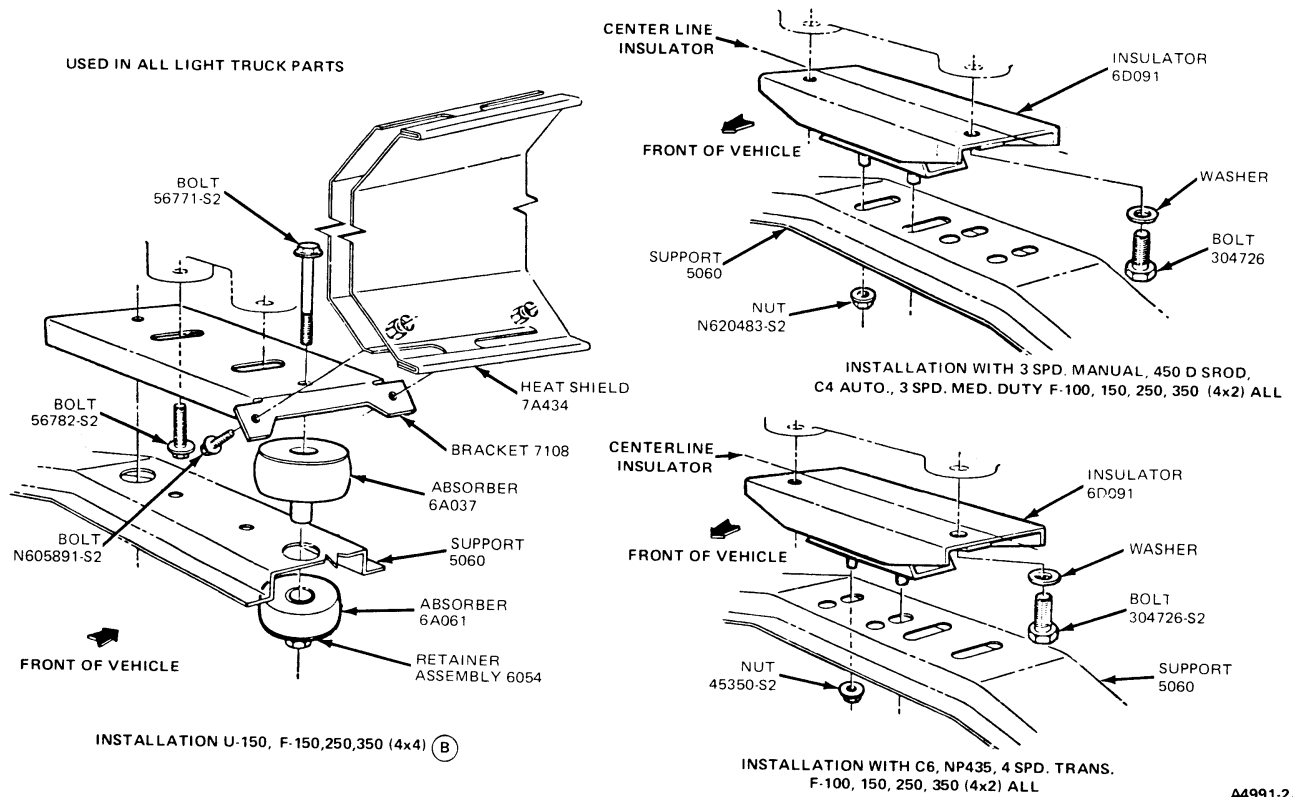


FIG. 11 Engine Rear Support—F-100—F-350 (4x2) and Bronco

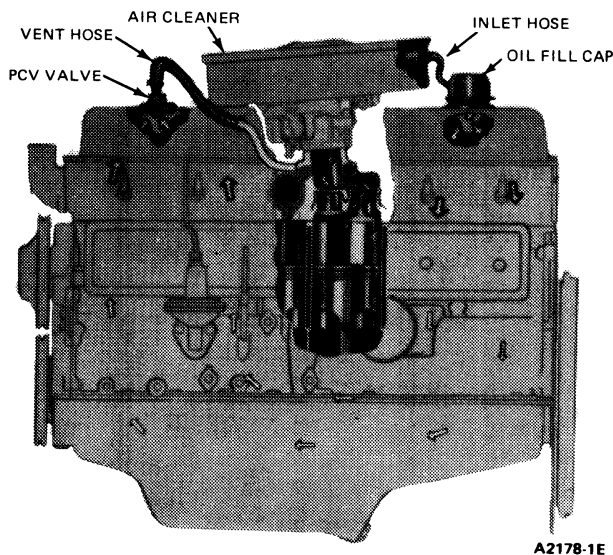


FIG. 12 Typical Closed-Type Crankcase Ventilation System

VALVE ROCKER ARM COVER AND ROCKER ARM

Removal

1. Disconnect the inlet air hose at the oil fill cap. Remove the air cleaner.
2. Disconnect the accelerator cable at the carburetor. Remove the cable retracting spring. Remove the accelerator cable bracket from the cylinder head and position the cable and bracket assembly out of the way.

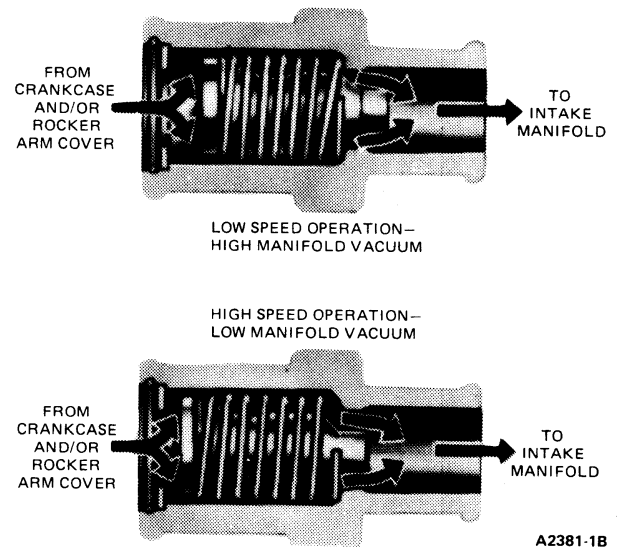
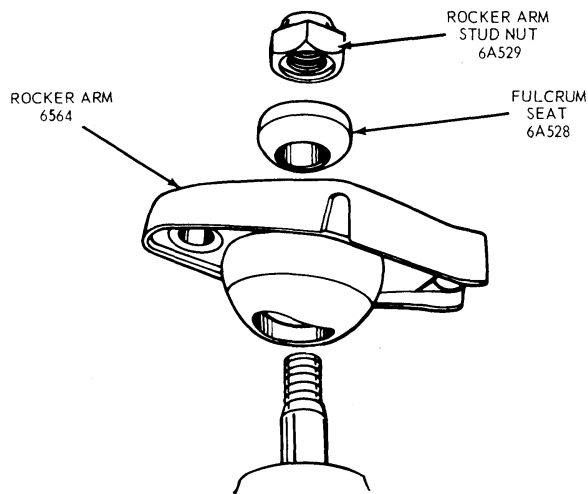


FIG. 13 PCV Valve

3. Remove the PCV valve from the valve rocker arm cover. Remove the cover bolts and remove the valve rocker arm cover.
4. Remove the valve rocker arm stud nut, fulcrum seat and rocker arm (Fig. 14).

Inspect the rocker arm cover bolts for worn or damaged seals under the bolt heads and replace as necessary. If removal of the rocker arm stud is necessary, refer to the procedure under Cylinder Head Repairs in Part 21-01.



A1634-1E

FIG. 14 Valve Rocker Arm Assembly**Installation**

1. Apply Lubriplate or equivalent to the top of the valve stem and at the push rod guide in the cylinder head.
2. Apply Lubriplate or equivalent to the rocker arm fulcrum seat and the fulcrum seat socket in the rocker arm. Install the valve rocker arm, fulcrum seat and stud nut. Adjust the valve clearance following the procedure in this Part under Valve Clearance Adjustment.
3. Clean the valve rocker arm cover and the cylinder head gasket surface. Place the new gasket in the cover making sure that the tabs of the gasket engage the notches provided in the cover.
4. Install the cover on the cylinder head. Make sure the gasket seats evenly all around the head. Partially tighten the cover bolts in sequence, starting at the middle bolts. Then tighten the bolts to specifications in the same sequence.
5. Install the PCV valve in the rocker arm cover. Install the accelerator cable bracket on the cylinder head and connect the cable to the carburetor.
6. Connect the inlet air hose to the oil fill cap.
7. Install air cleaner.

VALVE SPRING, RETAINER AND STEM SEAL

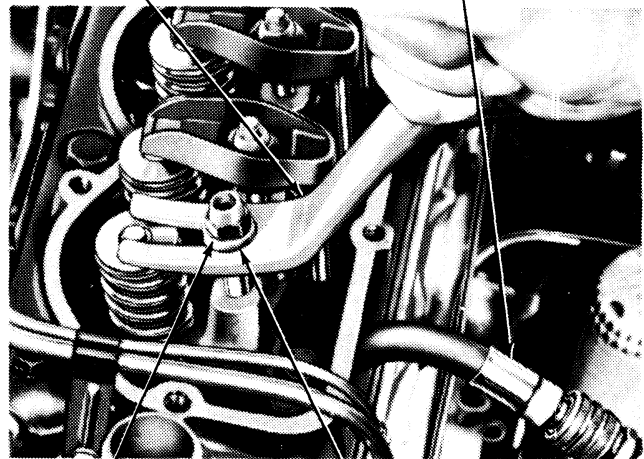
Broken valve springs or worn or damaged valve stem seals and retainers may be replaced without removing the cylinder head providing damage to the valve or valve seat has not occurred.

Removal

1. Remove the air cleaner.
2. Remove the accelerator cable retracting spring. Disconnect the accelerator cable at the carburetor. Disconnect the choke cable at the carburetor.
3. Remove the PCV valve from the valve rocker arm cover and remove the valve rocker arm cover. Remove the applicable spark plug.
4. Crank the engine until the applicable piston is on TDC at the end of the compression stroke.

5. Install an air line adapter in the spark plug hole (Fig. 15) and connect the air line.

TOOL T62F-6565-A (6513-HH)

AIR LINE ADAPTER
TOOL 6513-ABA OR 6513-AB

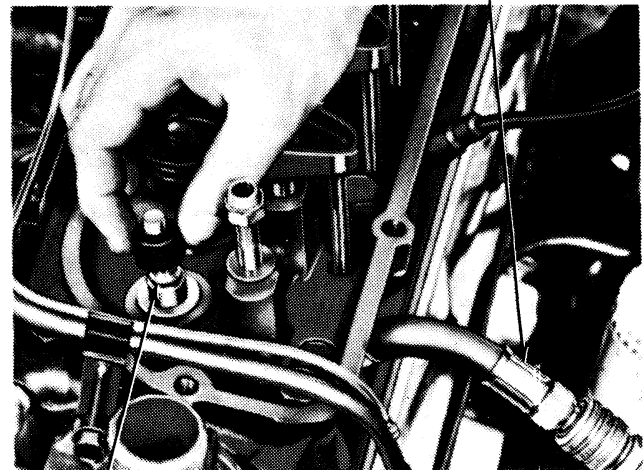
ROCKER ARM STUD NUT

FULCRUM SEAT

A2141-1A

FIG. 15 Compressing Valve Spring—In-Chassis

6. Remove the applicable valve rocker arm stud nut, fulcrum seat, valve rocker arm and push rod. Install the stud nut and position the compressor tool as shown in Fig. 15. Compress the valve spring and remove the retainer locks, spring retainer and valve spring. Remove and discard the valve stem seal (Fig. 16).

AIR LINE ADAPTER
TOOL 6513-ABA OR 6513-AB

OIL SEAL

A2821-1B

FIG. 16 Removing or Installing Valve Stem Seal

If air pressure fails to hold the valve in the closed position during this operation, it can be presumed that the valve is not seating or is damaged. If this condition occurs, remove the cylinder head for further inspection.

7. If air pressure has forced the piston to the bottom of the cylinder, any removal of air pressure will allow the valve to fall into the cylinder. A rubber band, tape or string wrapped around the end of the valve stem will prevent this condition and will still allow enough travel to check the valve for binds.

8. Inspect the valve stem for damage. Rotate the valve and check the valve stem tip for eccentric movement during rotation. Move the valve up and down through normal travel in the valve guide and check the stem for binds. **If the valve has been damaged, it will be necessary to remove the cylinder head for repairs as outlined in Part 21-01.**
9. If the condition of the valve proved satisfactory, hold the valve in the closed position and apply air pressure within the cylinder.

Installation

1. Oil the valve stem with heavy engine oil and install a new valve stem seal (Fig. 16). Place the spring in position over the valve. **Be sure the closed coil end is next to the cylinder head.**
Install the valve spring retainer. Compress the valve spring and install the valve spring retainer locks. Remove the compressor tool and stud nut.
2. Apply Lubriplate or equivalent to both ends of the push rod. Install the push rod. Apply Lubriplate or equivalent to the tip of the valve stem.
3. Apply Lubriplate or equivalent to the fulcrum seat and socket. Install the valve rocker arm, fulcrum seat and stud nut. Adjust the valve clearance following the procedure given in this Part under Valve Clearance Adjustment.
4. Turn off the air and remove the air line and adapter. Install the spark plug and connect the spark plug wire.
5. Clean the valve rocker arm cover and cylinder head gasket surface. Place the new gasket in the cover making sure that the tabs of the gasket engage the notches provided in the cover. Install the cover, making sure that the gasket seats evenly around the cylinder head. Install the cover bolts and tighten them in sequence (starting in the center) to specifications.
6. Connect the accelerator cable to the carburetor. Install the accelerator cable retracting spring. Connect the choke cable to the carburetor.
7. Install the PCV valve in the valve rocker arm cover. Install the air cleaner.

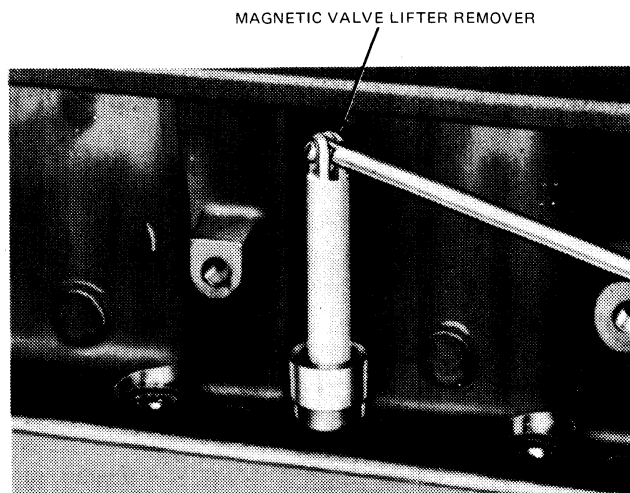
VALVE LIFTER

Removal

1. Remove the air cleaner. Remove the PCV valve from the valve rocker arm cover.
2. Disconnect the choke cable at the carburetor. Disconnect the accelerator and throttle cable at the carburetor. Remove the retracting spring.
3. Remove the coil bracket attaching bolt and position the coil out of the way.
4. Remove the valve rocker arm cover.
5. Disconnect the spark plug wires at the spark plugs and the secondary high tension wire from the coil. Remove the distributor cap and spark plug wire assembly.
6. Remove the valve push rod cover.
7. Loosen the rocker arm stud nut(s) until the rocker arm(s) can be disengaged from the push rod(s).

Remove the push rod(s). Remove the valve lifter(s) with the tool shown in Fig. 17. If more than one push rod and valve lifter is removed, do it in sequence and place the parts in a rack so they can be installed in their original locations.

Refer to Part 21-01 for the cleaning, inspection and testing procedures.



A2928-1A

FIG. 17 Removing or Installing Valve Lifter

Installation

1. Clean the external surfaces of the valve lifters, rocker arm cover, push rod cover, cylinder head and block gasket surfaces.
2. Apply Lubriplate or equivalent to the cam lobe contact surface of the valve lifter(s). Coat the rest of the valve lifter(s) with engine oil. Install the valve lifters with the tool shown in Fig. 17.
3. Apply Lubriplate or equivalent to both ends of the push rod(s). Install the push rod(s) in sequence. Engage the rocker arm(s) with push rod(s) and tighten the rocker arm stud nut(s) sufficiently to hold the push rod(s) in place. **Be sure each push rod is properly seated in the valve lifter socket.**
4. Adjust the valve clearance, following the procedure given in this Part.
5. Coat one side of a new push rod cover gasket with oil-resistant sealer and position to the push rod cover. Install the push rod cover. Tighten the cover screws in sequence to specifications. Clean the rocker arm cover. Place the new gasket in the cover making sure that the tabs of the gasket engage the notches provided in the rocker arm cover. Install the cover and tighten the bolts to specification. Install the PCV valve in the rocker arm cover.
6. Position the coil on the cylinder head and install the attaching bolt.
7. Install the distributor cap and spark plug wire assembly. Connect the spark plug wires and coil secondary high tension wire.
8. Connect the accelerator cable and throttle cable to the carburetor. Install the cable retracting spring. Connect the choke cable to the carburetor.

9. Install the air cleaner. Start the engine and adjust the carburetor idle speed to specification on the engine decal.

CYLINDER HEAD

Removal

If the cylinder head is to be replaced, follow the procedures under Cylinder Head Disassembly and Assembly. Transfer all valves, springs, spark plugs, etc., to the new cylinder head. Clean and inspect all parts, reface the valves and check valve guide clearances (refer to Part 21-01) before assembling the used parts to the new cylinder head.

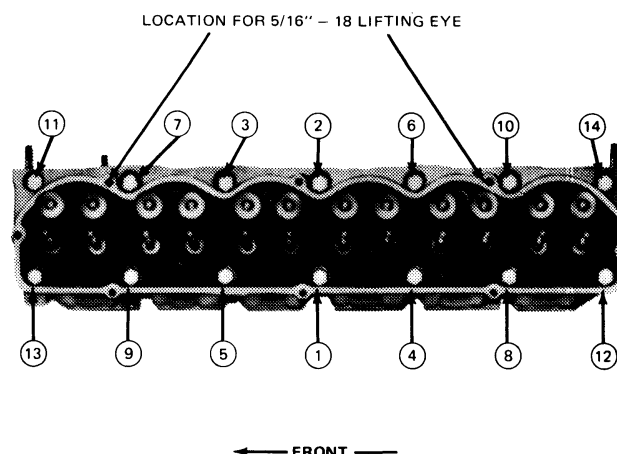
1. Drain the cooling system.
2. Remove the air cleaner.
3. Remove the PCV valve from the rocker arm cover. Disconnect the vent hose at the intake manifold.
4. Disconnect and remove the carburetor fuel inlet line and the distributor vacuum line.
5. Remove the accelerator cable retracting spring. Disconnect the accelerator cable from the carburetor.

On a vehicle with an automatic transmission, disconnect the kickdown rod at the carburetor.

6. Disconnect the radiator upper hose and heater hose at the coolant outlet elbow.
7. Disconnect the muffler inlet pipe from the exhaust manifold. Discard the inlet pipe gasket.
8. Remove the coil bracket attaching bolt and position the coil out of the way.
9. Remove the valve rocker arm cover. Loosen the rocker arm stud nuts so that the rocker arms can be rotated to one side.
10. Remove the valve push rods in sequence and identify them so that they can be installed in their original position.
11. Disconnect the spark plug wires at the spark plugs.
12. Remove the cylinder head bolts. Install the cylinder head lifting eyes in the locations shown in Fig. 18. Position a floor crane and attach the hoist and lifting sling to the lifting eyes. Lift the cylinder head and intake and exhaust manifolds assembly off the engine. **Do not pry between the head and block as the gasket surfaces may become damaged.**

Installation

1. Clean the cylinder head and cylinder block gasket surfaces. Clean the exhaust manifold and muffler inlet pipe gasket surfaces.
2. If the cylinder head was removed for a cylinder head gasket replacement, check the flatness of the head and block gasket surfaces (Part 21-01).
3. Position the gasket over the dowel pins on the cylinder block.
4. Install lifting eyes on the cylinder head in the location shown in Fig. 18 and use a floor crane and lifting sling to lift the cylinder head over the cylinder block. Lower it carefully until it is properly positioned on the block and dowel pins. Remove the hoist and lifting eyes.



A3187-1A

FIG. 18 Cylinder Head Bolts—Torque Sequence

5. Coat the threads of the cylinder head bolts with engine oil. Install the bolts.
6. Tighten the bolts in sequence (Fig. 18) to specifications. When cylinder head bolts have been tightened it is not necessary to re-tighten the bolts after extended operation.
7. Apply Lubriplate or equivalent to both ends of the push rods. Install the push rods in their original bores, positioning the lower end of the rods in the valve lifter sockets.
8. Apply Lubriplate or equivalent to the rocker arm fulcrum seat and the fulcrum seat socket in the rocker arm. Position the rocker arms and tighten the stud nuts just enough to hold the push rods in position. Adjust the valve clearance, following the procedure in this section.
9. Clean the valve rocker arm cover. Place the new gasket in the cover making sure that the tabs of the gasket engage the notches provided in the cover. Position the cover, making sure that the gasket seats evenly around the cylinder head. Install the cover bolts and tighten in sequence (starting in the center) to specifications.
10. Connect the spark plug wires to the spark plugs.
11. Connect the crankcase vent hose to the inlet tube in the intake manifold. Install the PCV valve in the valve rocker arm cover.
12. Position the fuel inlet line and the distributor vacuum line on the engine. Connect the distributor vacuum line to the distributor and carburetor. Connect the carburetor fuel inlet line to the carburetor and fuel pump.
13. Connect the accelerator cable to the carburetor. Install the accelerator cable retracting spring.
14. On a vehicle with an automatic transmission, connect the kickdown rod to the carburetor.
15. Connect the radiator upper hose to the coolant outlet housing. Connect the heater hose to the coolant outlet housing, but do not tighten the clamp.
16. Fill and bleed the cooling system, then tighten the heater hose clamp.

17. Operate the engine until engine temperatures have stabilized. Adjust the engine idle speed to specification on engine decal. Check for fuel, oil and coolant leaks.
18. Install the air cleaner.

MANIFOLDS

Removal

1. Remove the air cleaner. Disconnect the accelerator cable or rod at the carburetor. Remove the accelerator retracting spring.
2. On a vehicle with automatic transmission, remove the kick-down rod retracting spring. Remove the accelerator rod bellcrank assembly.
3. Disconnect the fuel inlet line.
4. Disconnect and label all vacuum lines from the carburetor.
5. Disconnect the muffler inlet pipe from the exhaust manifold.
6. Disconnect the power brake vacuum line (if so equipped).
7. Remove the bolts and nuts attaching the manifolds to the cylinder head. Lift the manifold assemblies from the engine. Remove and discard the gaskets.
8. To separate the manifolds, remove the nuts joining the intake and exhaust manifolds.

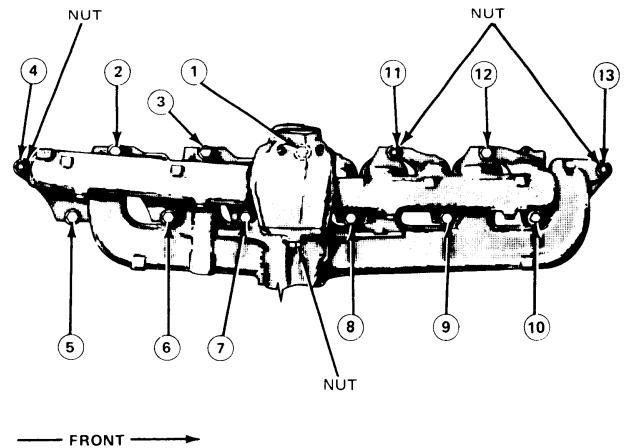
Installation

If the exhaust gas control valve requires replacement, follow the procedures in Part 21-01.

1. Clean the mating surfaces of the cylinder head and manifolds.
2. If one of the manifolds is to be replaced, remove the tube fittings from the discarded manifolds and install them in the new manifold as required. Also install new studs in the new manifold.
3. If the intake and exhaust manifolds have been separated, coat the mating surfaces lightly with graphite grease and place the exhaust manifold over the studs on the intake manifold. Install the lockwashers and nuts. Tighten them finger tight.
4. Install a new intake manifold gasket.
5. Coat the mating surfaces lightly with graphite grease. Place the manifold assemblies in position against the cylinder head. **Make sure that the gaskets have not become dislodged. Install the attaching washers, bolts and nuts.** Tighten the bolts and nuts to specifications in the sequence shown in Fig. 19.

If the intake and exhaust manifolds were separated, tighten the nuts joining them.

6. Position a new gasket on the muffler inlet pipe and connect the inlet pipe to the exhaust manifold. Tighten the nuts to specifications.
7. Connect the crankcase vent hose to the intake manifold and position the hose clamp.
8. Connect the fuel inlet line and all vacuum lines to the carburetor.
9. Connect the accelerator cable to the carburetor and install the retracting spring.
10. On a vehicle with an automatic transmission, install



A3186-1C

FIG. 19 Intake and Exhaust Manifolds Torque Sequence

the bellcrank assembly and kickdown rod retracting spring. Adjust the transmission control linkage.

11. Install the air cleaner. Adjust the engine idle speed to the Specifications on the Engine Decal.

WATER PUMP

Removal

1. Drain the cooling system. Loosen the alternator adjusting arm bolt and remove the alternator drive belt. On a vehicle with an air compressor, remove the compressor belt.
2. Remove the fan, spacer and pulley (Figs. 8 and 20).
3. Disconnect the heater hose, radiator lower hose and radiator supply line at the water pump.
4. Remove the bolts attaching the water pump to the block. Remove the pump and gasket.

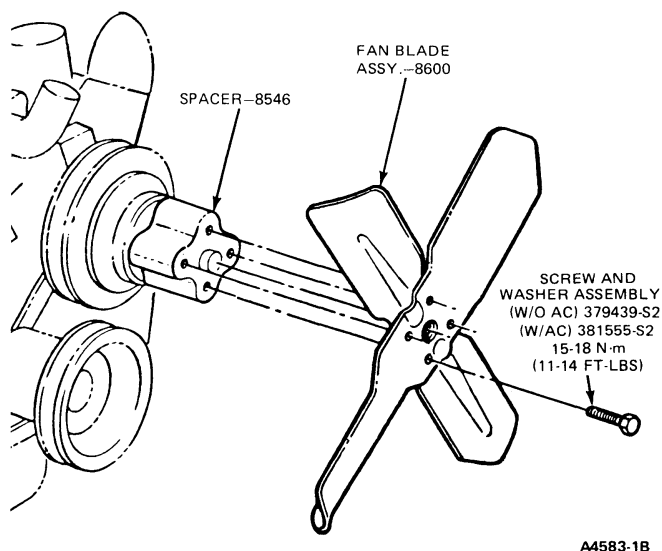
Installation

1. Remove the fittings from the old pump and install them on the new pump. Clean all gasket material from the mounting surfaces of the water pump and cylinder block.
2. Position a new gasket, coated on both sides with sealer, on the water pump.
3. Install the pump body on the block. Install the pump attaching bolts, coated with sealer and tighten the bolts to specifications.
4. Connect the radiator lower hose, radiator supply line and heater hose. Install the pulley, spacer and fan (Figs. 8 and 20). Install the alternator belt and adjust the belt tension. On a vehicle with an air compressor, install the air compressor belt and adjust the belt tension to specifications. Fill and bleed the cooling system. Operate the engine and check for leaks.

CYLINDER FRONT COVER AND FRONT OIL SEAL

Removal

1. Drain the cooling system.



A4583-1B

FIG. 20 Fan Blade Installation—E-100—E-350

2. Remove the shroud and radiator.
3. Remove the alternator adjusting arm bolt, loosen the drive belt and swing the adjusting arm aside. Remove the fan, drive belts, spacer and pulleys (Figs. 8 and 20).
4. Remove the screw and washer from the end of the crankshaft and remove the damper (Fig. 21).

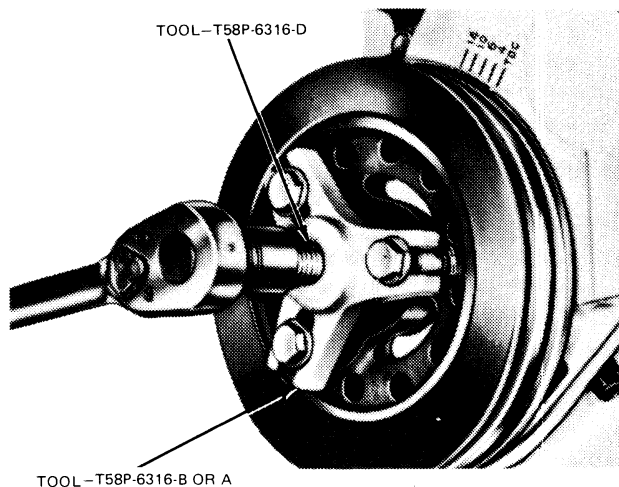
5. Remove the front oil pan and front cover attaching screws.

CAUTION: AVOID FOREIGN MATERIAL FROM ENTERING THE CRANKCASE DURING SERVICE WORK OR THE CRANKCASE OIL WILL HAVE TO BE CHANGED.

6. Remove the cylinder front cover and discard the gasket. It is a good practice to replace the crankshaft oil seal when the cylinder front cover is removed.
7. Drive out the oil seal with a pin punch. Clean the seal bore in the cover.

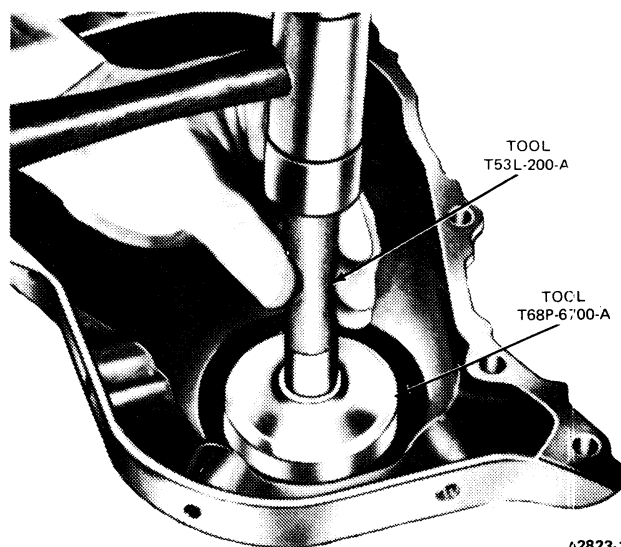
Installation

1. Coat a new crankshaft oil seal with grease and install the seal in the cover (Fig. 22). Drive the seal in until it is fully seated in the seal bore.
2. Cut the old front oil pan seal flush at the cylinder block/pan junction. Remove the old seal material.
3. Clean all gasket surfaces—front cover, block, and oil pan.
4. Cut and fit the new pan seal flush to the cylinder block/pan junction. (Old seal may be helpful as a pattern.)
5. Coat the gasket surfaces of the block and cover with oil resistant sealer. Position a new front cover gasket on the block.
6. Align the pan seal locating tabs with the pan holes, pull the seal tabs through until the seal is completely seated. Apply RTV silicone sealer or equivalent to the block/pan junction (Fig. 23).
7. Position the front cover assembly over the end of the crankshaft and against the cylinder block. Start the cover and pan attaching screws. Slide the cover alignment tool over the crank stub and into the seal



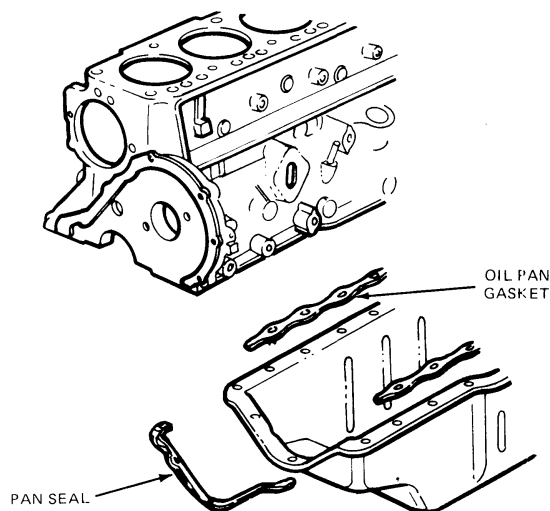
A2822-1B

FIG. 21 Removing Crankshaft Damper



A2823-1B

FIG. 22 Installing Crankshaft Front Oil Seal



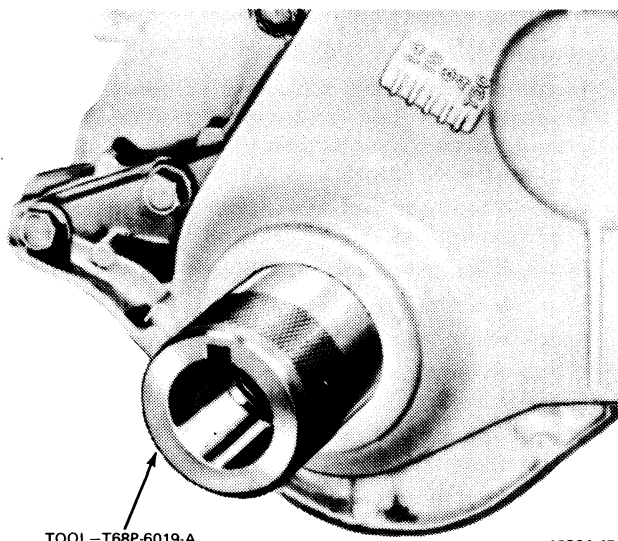
A4872-1A

FIG. 23 Oil Pan Gaskets and Front Seal Installed (Typical)

bore of the cover (Fig. 24). Install alternator adjusting arm, tighten all attaching oil pan and front cover screws to specification.

NOTE: Tighten the oil pan screws first (compress pan seal) to obtain proper cover alignment.

8. Lubricate the crank stub, damper hub I.D. and the seal rubbing surface with Lubriplate. Align the damper keyway with the key on the crankshaft and install the damper (Fig. 25).
9. Install the washer and capscrew. Tighten to specification.
10. Install the pulley(s), drive belt(s), spacer (if used) and fan (Figs. 8 and 20). Adjust all drivebelt tensions to specification. Refer to the Specifications listed at the end of this Part.
11. Install the shroud, radiator, and hoses.
12. Fill and bleed the cooling system. Use the specified antifreeze mix. Refer to Part 27-02, General Cooling System Service. If foreign material has not entered the crankcase during the service work, it is not necessary to change the engine oil.
13. Operate the engine at fast idle and check for coolant and oil leaks.



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A2824-1B

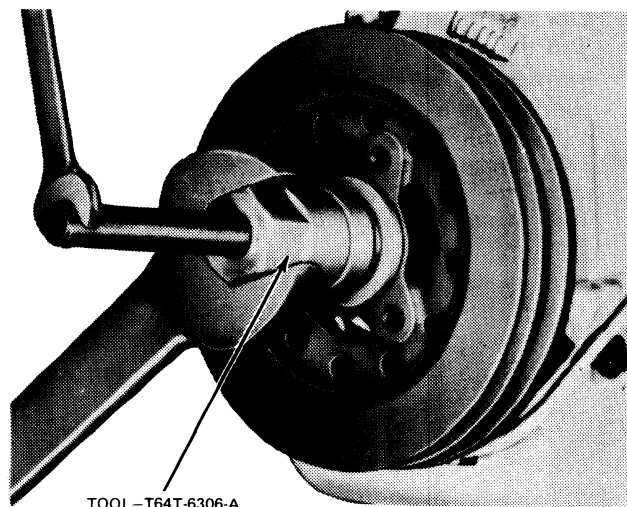
FIG. 24 Aligning Cylinder Front Cover

OIL PAN

F-100-F-350 and Bronco

Removal

1. Drain the crankcase, also drain the cooling system.
2. Remove the radiator following procedures in Group 27.
3. Raise the vehicle on a hoist. Disconnect the starter cable at the starter on the F-100-150-250 and remove the attaching bolts and starter.
4. Remove the engine front support insulator to support bracket nuts and washers on both supports. Raise the front of the engine with a transmission jack and wood block and place 1-inch thick wood blocks between the front support insulators and support brackets. Lower the engine and remove the transmission jack.



TOOL-T64T-6306-A

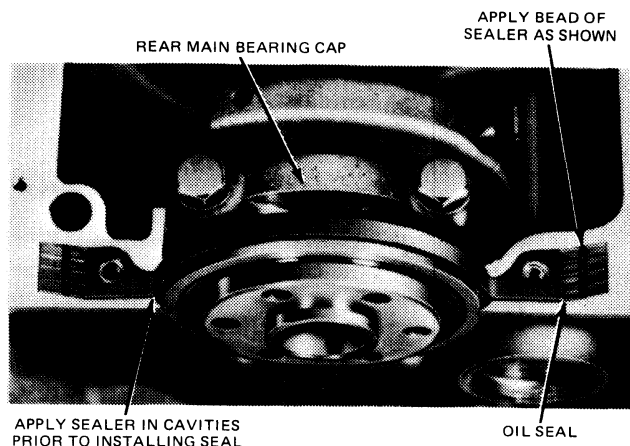
A2825-1A

FIG. 25 Installing Damper

5. Remove the oil pan attaching bolts and lower the pan to the crossmember. Remove the 2 oil pump inlet tube and screw assembly bolts and drop the assembly in the pan. Remove the oil pan. Remove the oil pump inlet tube attaching bolts. Remove the inlet tube and screen assembly from the oil pump and leave it in the bottom of the oil pan. Remove the oil pan gaskets. Remove the inlet tube and screen from the oil pan.

Installation

1. Clean the gasket surfaces of the oil pump, oil pan and cylinder block. Remove the rear main bearing cap to oil pan seal and cylinder front cover to oil pan seal. Clean the seal grooves.
2. Apply oil-resistant sealer in the cavities between the bearing cap and cylinder block (Fig. 26). Install a new seal in the rear main bearing cap and apply a bead of oil-resistant sealer to the tapered ends of the seal.



OIL SEAL

A2840-1A

FIG. 26 Installing Oil Pan Rear Seal

3. Install new side gaskets on the oil pan with oil-resistant sealer (Fig. 23). Position a new oil pan to cylinder front cover seal on the oil pan.

4. Clean the inlet tube and screen assembly and place it in the oil pan.
5. Position the oil pan under the engine. Install the inlet tube and screen assembly on the oil pump with a new gasket. Tighten the screws to specifications. Position the oil pan against the cylinder block and install the attaching bolts (Fig. 27). Tighten the bolts in sequence to specifications.

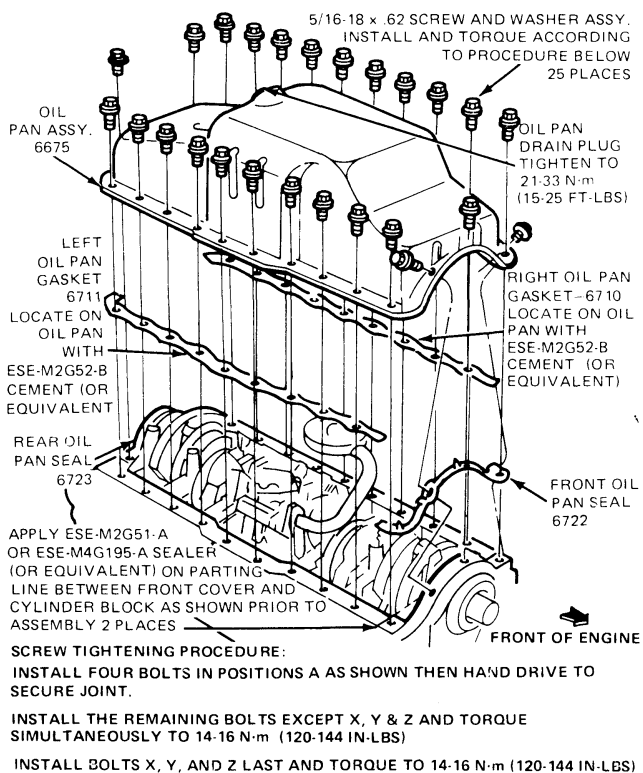


FIG. 27 Oil Pan Installation

6. Raise the engine with a transmission jack and remove the wood blocks from the engine front supports. Lower the engine until the front support insulators are positioned on the support brackets. Install the washers and nuts on the insulator studs and tighten the nuts to specifications.
7. Install the starter and connect the starter cable.
8. Lower the vehicle. Install the radiator following procedures in Group 27.
9. Fill the crankcase and cooling system.
10. Start the engine and check for coolant and oil leaks.

E-100—E-350

Removal

1. Remove engine cover.
2. Remove air cleaner and carburetor.
3. If vehicle is equipped with air conditioning, discharge the refrigerant from the system and remove compressor (see truck shop manual Part 36-30).
4. Remove the EGR valve.

5. If vehicle is an E350, disconnect thermactor check valve inlet hose and remove check valve.
6. Remove upper radiator hose.
7. Unbolt fan shroud and remove, or position the shroud on the fan.
8. If vehicle has automatic transmission, remove transmission fill tube.
9. Remove exhaust inlet pipe to manifold nuts.
10. Raise vehicle on hoist and disconnect fuel pump inlet hose. Plug the line.
11. Remove alternator heat shield and front engine support nuts.
12. Remove power steering return line clip located in front of the No. 1 crossmember.
13. Disconnect lower radiator hose and transmission cooler lines.
14. Remove the starter.
15. Raise the engine and place 3 inch blocks under the engine mounts. Remove the oil pan dipstick tube from the oil pan.
16. Remove oil pan bolts and the pickup tube and screen from the oil pump. Remove the pan.
17. Clean oil pan, tube and screen assembly and the gasket surfaces of the block and oil pan.

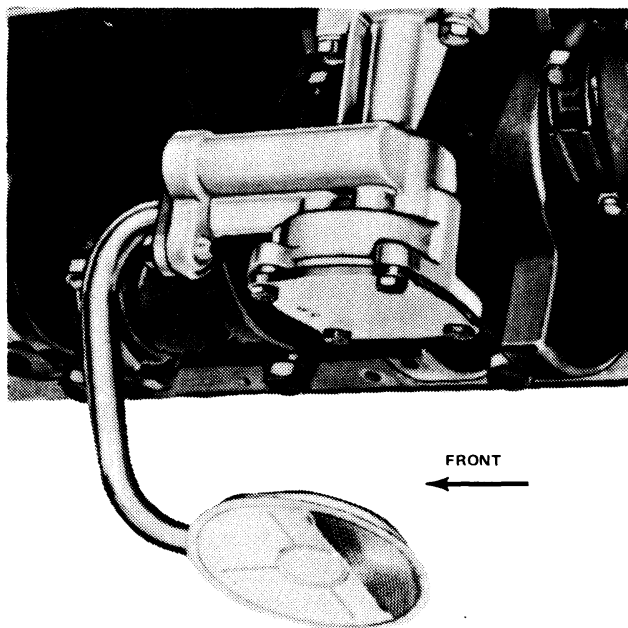
Installation

1. Install the oil pump tube and screen assembly. Cement the oil pan gasket and position it to the pan. Position a new oil pan to cylinder front cover seal on the oil pan.
2. Position the rear seal to the rear bearing cap and apply sealer (Fig. 26) and install the oil pan.
3. Install the dipstick tube and lower the engine.
4. Install the support nuts.
5. Install the starter and connect the fuel line.
6. Install lower radiator hose and transmission cooler lines.
7. Install the power steering return line clip and position the line.
8. Install the alternator heat shield and lower the hoist.
9. Install the EGR valve and carburetor. Connect the exhaust.
10. Install thermactor check valve and connect inlet hose (E350 only).
11. Install fan shroud and upper radiator hose. Replace engine coolant.
12. Install A/C compressor and charge system (see truck shop manual Part 36-30).
13. Replace the oil filter and fill the crankcase. Start the engine and check for leaks.
14. Install air cleaner and adjust the carburetor curb idle speed to specifications on engine decal. Install engine cover.

OIL PUMP

Removal

1. Remove the oil pan following the procedures under Oil Pan Removal.
2. Remove the oil pump attaching bolts (Fig. 28) and remove the pump assembly.



A2164-1A

FIG. 28 Oil Pump Installed**Installation**

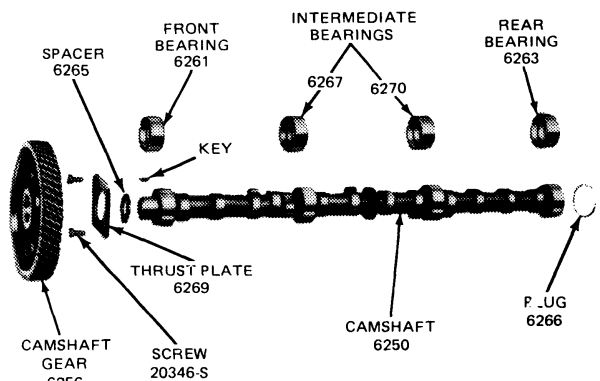
1. Prime the oil pump by filling the inlet opening with oil and rotate the pump shaft until oil emerges from the outlet opening.
2. Install the oil pump on the cylinder block. Tighten the attaching bolts to specifications.
3. Install the oil pan following the procedures under Oil Pan Installation.

CAMSHAFT

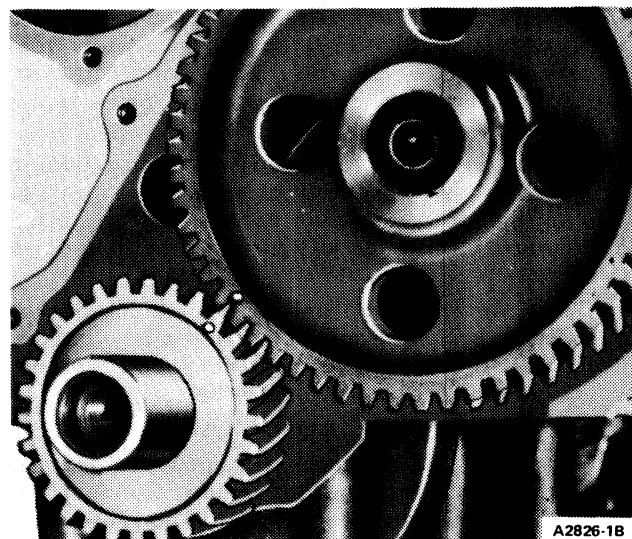
The camshaft and related parts are shown in Fig. 29.

Removal

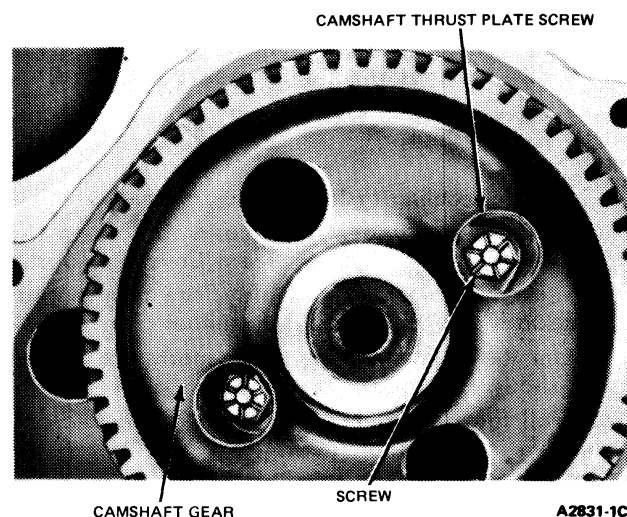
1. Drain the cooling system and the crankcase.
2. Remove the shroud and radiator, valve lifters, cylinder front cover, following the procedures given in this Part and Part 27-04.
3. Disconnect the fuel outlet lines at the fuel pump. Remove the fuel pump mounting bolts and position the fuel pump out of the way.
4. Disconnect the vacuum line at the distributor and the primary wire at the coil. Remove the distributor following the procedure in Part 23-01 for breakerless ignition systems.
5. Check the camshaft end play, the timing gear backlash and the timing gear runout (Part 21-01).
6. Turn the crankshaft to align the timing marks as shown in Fig. 30.
7. Remove the camshaft thrust plate screws (Fig. 31). Remove the camshaft gear as shown in Fig. 32. Remove the key, thrust plate and spacer. Remove the camshaft. **Avoid damaging the camshaft lobes during removal.**



A2830-1A

FIG. 29 Camshaft Assembly

A2826-1B

FIG. 30 Aligning Timing Marks

A2831-1C

FIG. 31 Removing or Installing Camshaft**Installation**

If the camshaft end play, timing gear backlash and/or timing gear runout were excessive, make the necessary corrections before installing the camshaft.

1. Oil the camshaft bearing journals and apply Lubriplate or equivalent to all the lobes.
2. Assemble key, spacer and thrust plate to camshaft. Align the gear keyway with the key and install the gear on the camshaft as shown in Fig. 33.
3. Install the camshaft, gear and thrust plate as an assembly, making sure that the timing marks are in alignment (Fig. 30).
4. Tighten the thrust plate attaching screws to specifications.
5. Crank the engine until the timing marks are aligned. **Do not turn the crankshaft again until the distributor is installed.**
6. Clean the cylinder front cover and cylinder block gasket surfaces. Install a new oil seal in the cylinder front cover if necessary. **Clean the crankshaft damper and inspect it, following the procedures in Part 21-01.** Install the cylinder front cover and damper, valve lifters and radiator, following the installation procedures given in this Part and Part 27-04.

Install the distributor following the procedure in Part 23-01. With the rotor at No. 1 firing position, align the stator armature tooth exactly with the armature tooth prior to tightening the hold-down clamp.

7. Clean the fuel pump and cylinder block gasket surfaces. Install the fuel pump with a new gasket. Tighten the mounting bolts to specifications. Connect the fuel outlet line to the fuel pump.
8. Fill the crankcase and cooling system.
9. Start the engine and check for oil, coolant and fuel leaks. Adjust the ignition timing. Connect the distributor vacuum line to the distributor. Adjust the carburetor idle speed and fuel mixture to Specifications on the Engine Decal.

TIMING GEARS

To prevent possible damage to the camshaft lobes, do not rotate the camshaft or crankshaft in the engine without the timing gears installed.

CAMSHAFT GEAR

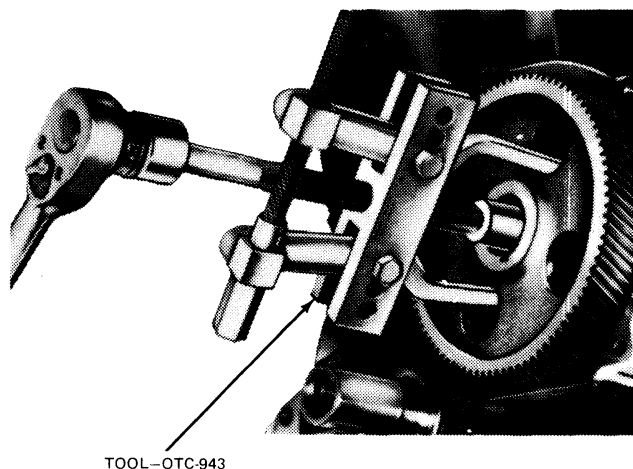
Removal

1. Drain the cooling system and crankcase.
2. Remove the cylinder front cover following the procedures under Cylinder Front Cover Removal.
3. Check the camshaft end play, the timing gear backlash and the timing gear runout (Part 21-01).
4. Crank the engine until the timing marks are aligned as shown in Fig. 30.
5. Install the gear puller as shown in Fig. 32 and remove the camshaft gear.

Installation

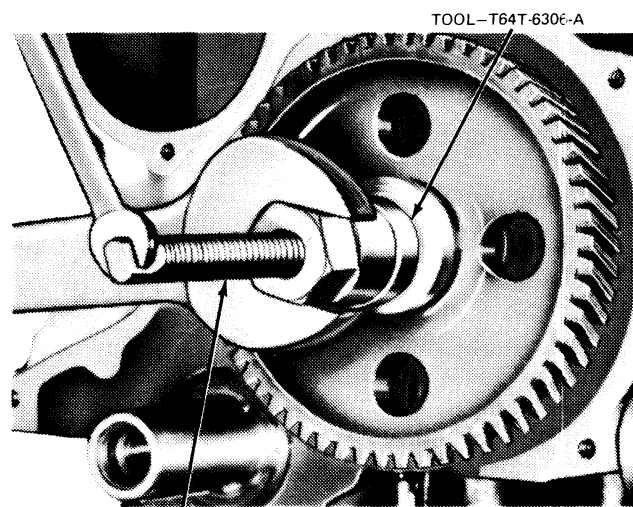
If the camshaft end play, timing gear backlash and/or timing gear runout were excessive, make the necessary corrections before installing the gear.

1. Be sure the key spacer and thrust plate are properly installed. Align the gear keyway with the key and install the gear on the camshaft as shown in Fig. 33. Be sure that the timing marks line up on the camshaft and crankshaft gears.



A3017-1A

FIG. 32 Removing Camshaft Gear



TOOL-T65L-6306-A

A2829-1B

FIG. 33 Installing Camshaft Gear

2. Install the cylinder front cover and related parts, following the procedures under Cylinder Front Cover Installation.
3. Fill the crankcase and cooling system. Start the engine and adjust the ignition timing. Operate the engine at fast idle and check all hose connections and gaskets for leaks. Reset Curb Idle to Specifications on the Engine Decal.

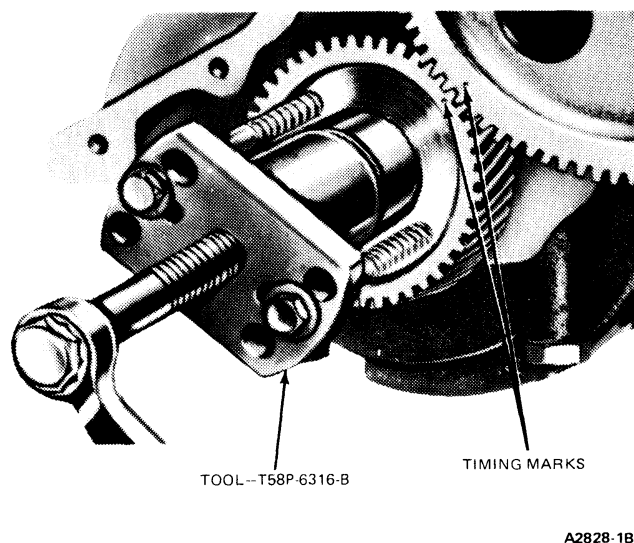
CRANKSHAFT GEAR

Removal

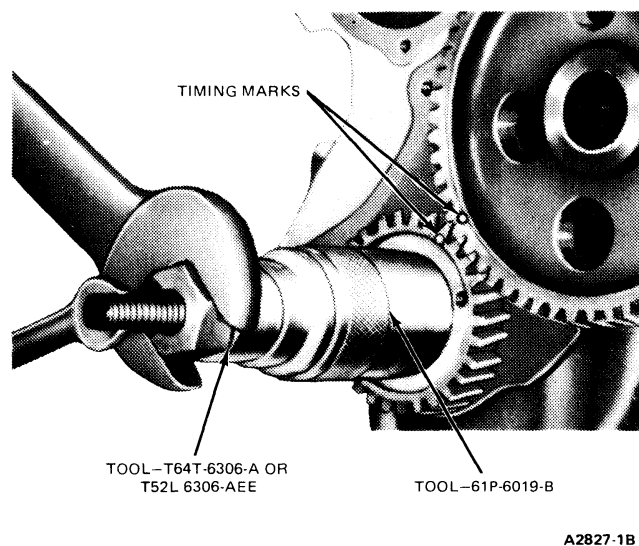
1. Drain the cooling system and crankcase. Remove the radiator, following the procedure in Group 27.
2. Remove the cylinder front cover.
3. Crank the engine until the timing marks are aligned as shown in Fig. 30.
4. Use the gear puller as shown in Fig. 34 and remove the crankshaft gear. Remove the key from the crankshaft.

Installation

1. Install the key in the crankshaft keyway. Install the

**FIG. 34 Removing Crankshaft Gear**

crankshaft gear, using the tool shown in Fig. 35. Be sure that the timing marks are aligned properly on the camshaft and crankshaft gears. Install the oil slinger.

**FIG. 35 Installing Crankshaft Gear**

2. Replace the crankshaft front oil seal and install the cylinder front cover, following the procedures under Cylinder Front Cover.
3. Install the radiator (refer to Group 27).
4. Fill the crankcase and the cooling systems (refer to Part 27-02, General Cooling System Service). Start the engine and check all gaskets and hose connections for leaks. Adjust the ignition timing and Curb Idle to the Specifications on the Engine Decal.

FLYWHEEL

Removal

1. Remove the transmission, following the procedure in Group 16 (Clutch and Manual Transmission) or Group 17 (Automatic Transmission).

2. On a manual-shift transmission, remove the clutch pressure plate and cover assembly and clutch disc, following the procedure in Group 16.
3. Remove the flywheel attaching bolts and remove the flywheel.

To check flywheel face runout or replace the flywheel ring gear, refer to Part 21-01.

Installation

1. Position the flywheel on the crankshaft flange. Coat the threads of the flywheel attaching bolts with oil-resistant sealer and install the bolts. Tighten the bolts in sequence across from each other to specifications.
2. On a manual-shift transmission, install the clutch disc and the pressure plate and cover assembly following the procedure in Group 16.
3. Install the transmission following the procedure in Group 16 or Group 17.

CLUTCH PILOT BEARINGS

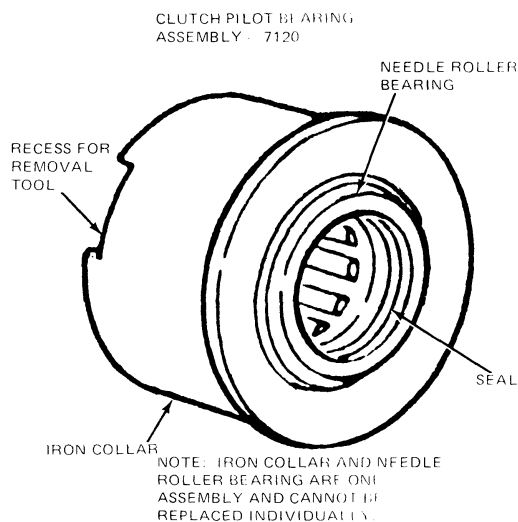
A needle roller bearing and adaptor assembly is used as a clutch pilot bearing on E-100—E-350, F-100—F-350, and Bronco vehicles (Fig. 36). It is inserted directly into the engine crankshaft. The bearing and adaptor assembly cannot be serviced separately. The needle bearing clutch pilot can only be installed with the seal end of the bearing facing the transmission. The bearing and seal are pregreased and do not require additional lubrication. A new bearing must be installed whenever a bearing is removed.

Removal

1. Remove the transmission, clutch pressure plate, and disc following the procedures in Group 16.
2. Using Tools T59L-100B and T58L-101-A or equivalent, remove the pilot bearing (Fig. 37).

Installation

1. Using Tool T65L-7600-A or equivalent install the pilot bearing with the seal facing the transmission (Fig. 38) so that the adaptor is not cocked.

**FIG. 36 Needle Pilot Bearing Assembly**

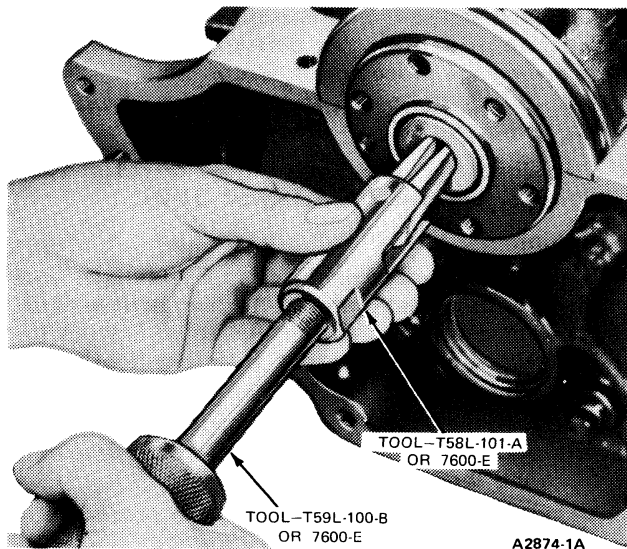


FIG. 37 Removing Clutch Pilot Needle Bearing Assembly

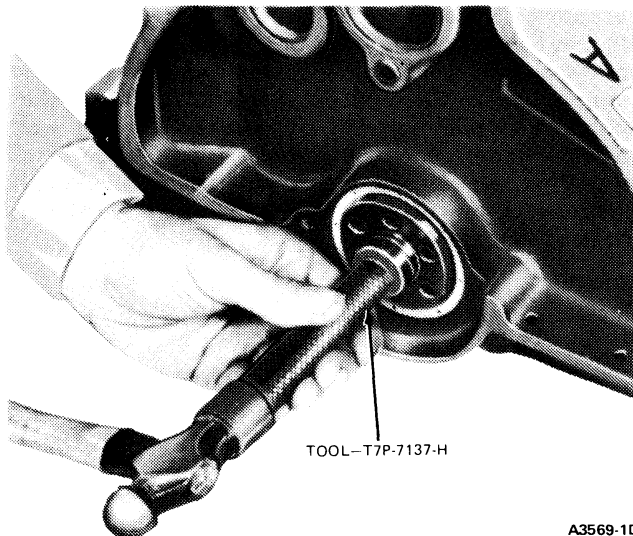


FIG. 38 Installing Clutch Pilot Bearing Assembly

2. Install the clutch pressure plate, disc, and transmission following the procedure in Group 16.

Note: Care must be taken not to damage the bearing during transmission installation while the transmission input shaft is being inserted into the bearing.

CAMSHAFT REAR BEARING BORE PLUG

Removal

1. Remove the transmission and flywheel housing, following the procedures in Group 16 (Manual Transmission) or Group 17 (Automatic Transmission). On a manual-shift transmission, remove the clutch pressure plate and disc following the procedures in Part 16-02.
2. Remove the flywheel attaching bolts. Remove the flywheel and the engine rear cover plate.
3. Refer to Part 21-01 to remove the core plug.

Installation

1. Replace the core plug as detailed in Part 21-01.
2. Install the engine rear cover plate and flywheel. Coat the flywheel attaching bolts with oil-resistant sealer and install the bolts snug. Tighten the flywheel bolts in sequence to specifications.

On a vehicle with a manual-shift transmission, install the clutch pressure plate and disc and transmission, following the procedure in Group 16.

On a vehicle with an automatic transmission, install the transmission and converter housing following the procedure in Group 17.

CRANKSHAFT REAR OIL SEAL

If the crankshaft rear oil seal replacement is the only operation being performed, it can be done in the vehicle as detailed in the following procedure. **If the oil seal is being replaced in conjunction with a rear main bearing replacement, the engine must be removed from the vehicle and installed on a work stand (Fig. 39).**

Removal

1. Remove the starter.
2. Remove the transmission from the vehicle, following the procedures in Group 16 (Manual Transmission) or Group 17 (Automatic Transmission).
3. On a manual-shift transmission, remove the pressure plate and cover assembly and the clutch disc following the procedure in Part 16-02.
4. Remove the flywheel attaching bolts and remove the flywheel and engine rear cover plate.
5. Use an awl to punch two holes in the crankshaft rear oil seal. Punch the holes on opposite sides of the crankshaft and just above the bearing cap to cylinder block split line. Install a sheet metal screw in each hole. Use two large screwdrivers or small pry bars and pry against both screws at the same time to remove the crankshaft rear oil seal. It may be necessary to place small blocks of wood against the cylinder block to provide a fulcrum point for the pry bars. **Use caution throughout this procedure to avoid scratching or otherwise damaging the crankshaft oil seal surface.**
6. Clean the oil seal recess in the cylinder block and main bearing cap.

Installation

1. Clean, inspect and polish the rear oil seal rubbing surface on the crankshaft, following the procedures in Part 21-01.

Coat a new oil seal and the crankshaft with a light film of engine oil. Start the seal in the recess with the seal lip facing forward and install it with the tool as shown in Fig. 40. Keep the tool straight with the centerline of the crankshaft and install the seal until the tool contacts the cylinder block surface. **Remove the tool and inspect the seal to be sure it was not damaged during installation.**

2. Install the engine rear cover plate. Position the flywheel on the crankshaft flange. Coat the threads of the flywheel attaching bolts with oil-resistant

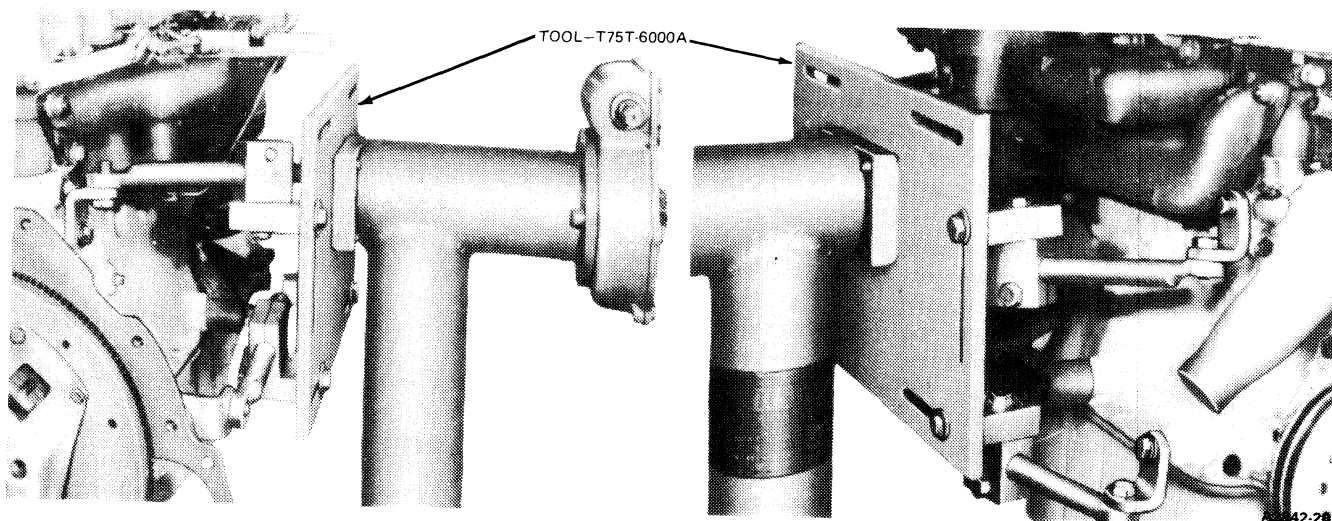


FIG. 39 Engine Mounted on Work Stand—Typical

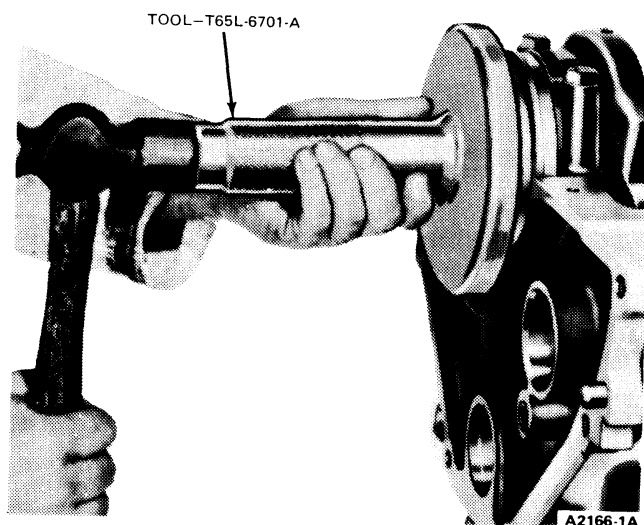


FIG. 40 Installing Crankshaft Rear Oil Seal

sealer and install the bolts. Tighten the bolts in sequence across from each other to specifications.

3. On a manual-shift transmission, install the clutch disc and the pressure plate assembly following the procedure in Part 16-02.
4. Install the transmission, following the procedure in Group 16 (Manual Transmission), or Group 17 (Automatic Transmission). **Do not adjust the transmission linkage.**

MAIN BEARING

Do not file or lap bearing caps or use shims to obtain the proper bearing clearance.

Bearings are available for service in standard sizes or 0.001 and 0.002 inch undersize. Refer to the Parts Catalog for the available sizes. Undersize bearings are available for use on journals that have been refinished.

If the rear main bearing is to be replaced, it will be necessary to remove the engine, install it on a work stand, replace the main bearing and replace the crankshaft rear oil seal.

Removal

1. Drain the crankcase. Remove the oil pan and oil pump, following the procedure under Oil Pan Removal.
2. **Replace one bearing at a time, leaving the other bearings securely fastened.** Remove the main bearing cap to which new bearings are to be installed.

Note: Loosen all main Bearing Caps to fingertight this will lower the Crankshaft and ease installation of New Bearings.

3. Insert the upper bearing remover (Tool 6331) in the oil hole in the crankshaft journal (Fig. 41).
4. Rotate the crankshaft in the direction of engine rotation to force the bearing out of the block.
5. Clean the crankshaft journal. When replacing standard bearings with new bearings, it is good practice to first try to obtain the proper clearance with standard bearings or a combination of a standard bearing and a 0.001 or 0.002 inch undersize bearing.

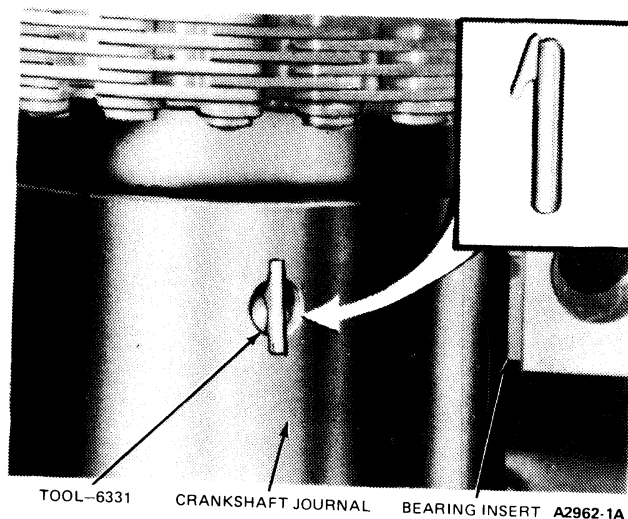


FIG. 41 Removing or Installing Upper Main Bearing Insert

Installation

1. **The upper and lower bearing halves are not interchangeable. The upper half is drilled and grooved to provide entry of oil.** Be sure bearings and surfaces are clean. Foreign material under the inserts will distort the bearings and cause failure.

To install the upper main bearing, place the plain end of the bearing over the shaft on the locking tang side of the block and partially install the bearing so that Tool 6331 can be inserted in the oil hole in the crankshaft journal (Fig. 41). With Tool 6331 positioned in the oil hole, rotate the crankshaft slowly in the opposite direction of engine rotation until the bearing is seated. Remove the tool.

Select-fit the bearing for proper clearance following procedures given under Fitting Main and Connecting Rod Bearings in Part 21-01.

2. After the bearing has been fitted, apply a light coat of engine oil to the journal and bearings; then, install the bearing cap. Tighten the cap bolts to specifications.
3. Repeat the procedure for the remaining bearings that require replacement.
4. If the thrust bearing cap (No. 5 main bearing) has been removed, install it as follows:

Install the thrust bearing cap with the bolts finger-tight. Pry the crankshaft forward against the thrust surface of the upper half of the bearing (Fig. 42). Hold the crankshaft forward and pry the thrust bearing cap to the rear. This will align the thrust surfaces of both halves of the bearing. Retain the forward pressure on the crankshaft. Tighten the cap bolts to specifications.

5. If the rear main bearing is replaced (on a work stand), clean the mating surfaces of the bearing cap and the block with Ford Spot Remover or equivalent solvent. Apply a 1/16 inch bead of RTV sealer, (C3AZ-19562-B or equivalent), in each corner of the rear main bearing cap saddle the full length of the saddle. **Be sure the main bearing is fitted and**

the cap bolts tightened to specifications before installing the new crankshaft rear oil seal.

6. Clean the oil pump inlet tube screen. Prime the oil pump by filling the inlet opening with oil and rotate the pump shaft until the oil emerges from the outlet opening.
7. Install the oil pump and oil pan, following the procedure under Oil Pan Installation
8. Fill the crankcase and cooling system. Refer to Part 50-29, procedures A-1, A-4, A-5. Start the engine and check for oil pressure. Operate the engine at fast idle and check for oil and coolant leaks.

CONNECTING ROD BEARING

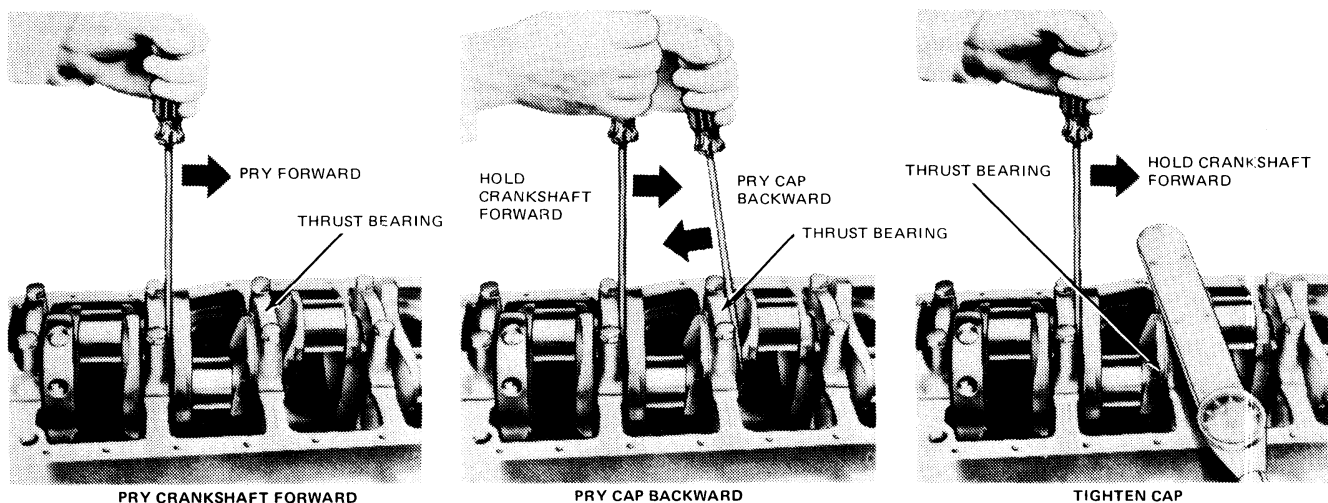
Removal

1. Drain the crankcase. Remove the oil pan and oil pump, following the procedure under Oil Pan Removal.
2. Turn the crankshaft until the connecting rod to which new bearings are to be fitted is down. Remove the connecting rod cap. Remove the bearing inserts from the rod and cap.
3. Be sure the bearing inserts and the bearing bore in the connecting rod and cap are clean. Foreign material under the inserts will distort the bearing and cause a failure.
4. Clean the crankshaft journal. When replacing standard bearings with new bearings, it is good practice to first try to obtain the proper clearance with standard bearings. Refer to Part 21-01 for the cleaning and inspection procedures.

Installation

1. Install the bearing inserts in the connecting rod and cap with the tangs fitted in the slots.
2. Pull the connecting rod assembly down firmly on the crankshaft journal.

Fit the bearing following procedures given in Part 21-01 under Fitting Main and Connecting Rod Bearings.



A2879-2A

FIG. 42 Aligning Thrust Bearing

3. After the bearing has been fitted, clean and apply a light coat of engine oil to the journal and bearings. Install the connecting rod cap and tighten the nuts to specifications.
4. Repeat the procedure for the remaining connecting rods that require new bearings.
5. Install the oil pan and oil pump, following the procedures under Oil Pan Installation in this section.
6. Fill the crankcase and cooling system. Refer to Part 50-29, procedures A-1, A-4, A-5. Start the engine and check for oil pressure. Operate the engine at fast idle and check for oil and coolant leaks.

PISTONS AND CONNECTING RODS

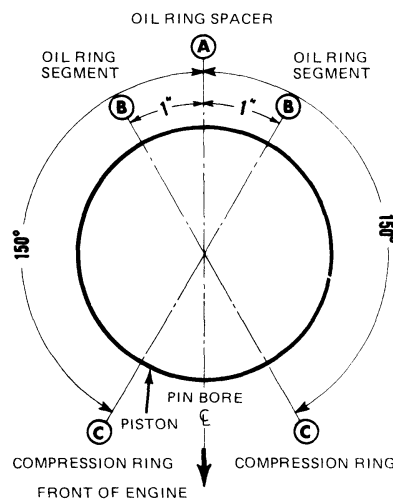
Removal

1. Drain the cooling system (refer to Part 27-02, General Cooling System Service), and the crankcase.
2. Refer to Cylinder Head Removal and remove the cylinder head and related parts.
3. Remove the oil pan following the procedure under Oil Pan Removal. Remove the oil pump inlet tube and the oil pump.
4. Turn the crankshaft until the piston to be removed is at the bottom of the stroke and place a cloth on the piston dome to collect the cuttings. Remove any ridge and/or deposits from the upper end of the cylinder bore with a ridge cutter. Follow the instructions furnished by the tool manufacturer. **Never cut into the ring travel area in excess of (1/32 inch) when removing ridges.**
5. Make sure all the connecting rod caps are marked so that they can be installed in their original positions. Remove the connecting rod cap.
6. Push the connecting rod and piston assembly up the top of the cylinder with the handle end of a hammer. Avoid damage to the crankshaft journal or the cylinder wall when removing the piston and rod.

Installation

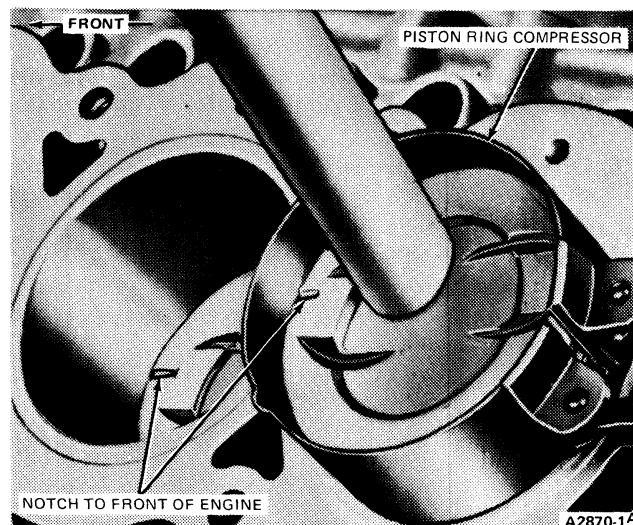
1. Clean the oil pump inlet tube screen and the oil pan and block gasket surfaces.
2. Oil the piston rings, pistons and cylinder walls with light engine oil.
3. **Be sure to install the pistons in the same cylinders from which they were removed or to which they were fitted.** The connecting rods and bearing caps are numbered from 1 to 6 beginning at the front of the engine. The number on the connecting rod and bearing cap must be on the same side of rod when installing in the cylinder bore. If a connecting rod is ever transferred from one cylinder block to another or from one cylinder to another, new bearings should be fitted and the connecting rod should be re-numbered to correspond with the new cylinder number.
4. Make sure the ring gaps (oil ring spacer -A, oil ring segment -B, and Compression ring -C) are properly spaced around the circumference of the piston (Fig. 43). Oil the rings, then install a piston ring compressor on the piston. Make sure that the indentation in the dome of piston is toward the

front, then push the piston into its bore with the handle end of a hammer until it is slightly below the top of the cylinder (Fig. 44). Be sure to guide the connecting rods to avoid damaging the crankshaft journals.



A2811-1A

FIG. 43 Piston Ring Gap Spacing



A2870-1A

FIG. 44 Piston Installation

5. Check the clearance of each bearing following the procedure under Fitting Main or Connecting Rod Bearing in Part 21-01.
6. After the bearings have been fitted, apply a light coat of engine oil to the journals and bearings.
7. Turn the crankshaft throw to the bottom of its stroke, then push the piston all the way down until the connecting rod bearing seats on the crankshaft journal. Install the connecting rod cap. Tighten the nuts to specifications.
8. After the piston and connecting rod assemblies have been installed, check the connecting rod side clearance on each crankshaft journal (Fig. 45).
9. Prime the oil pump by filling the inlet opening with oil and rotate the pump shaft until oil emerges from the outlet opening. Install the oil pump and the oil

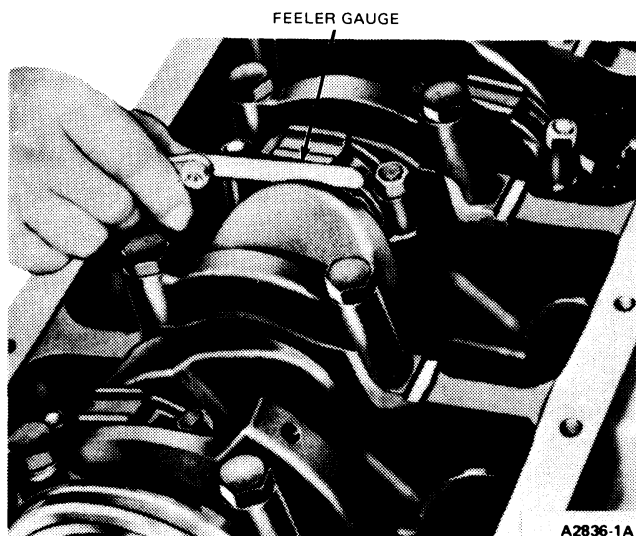


FIG. 45 Checking Connecting Rod Side Clearance

pump inlet tube. Install the oil pan and related parts. Follow procedures in this Part.

10. Refer to Cylinder Head Installation and install the cylinder head and related parts. Adjust the valve clearance as described in this Part.
11. Fill and bleed the cooling system. Fill the crankcase.
12. Start the engine and check for oil pressure. Operate the engine at fast idle and check for oil and coolant leaks.
13. Operate the engine until engine temperatures have stabilized. Check and adjust the ignition timing. Adjust the engine idle speed and fuel mixture to the Specifications on the Engine Decal.

On a vehicle with an automatic transmission, adjust the transmission control linkage. Refer to Part 17-02, Shift Control Linkage.

CRANKSHAFT

The crankshaft and related parts are shown in Fig. 46.

Removal

1. Install the engine on a work stand. Remove the spark plugs to allow easy rotation of the crankshaft. Drain the crankcase.
2. Remove the oil level dipstick.
3. Remove the crankshaft damper attaching bolt and lockwasher. Remove the crankshaft damper (Fig. 22).
4. Remove the cylinder front cover and gasket.
5. Remove the flywheel and engine rear cover plate.
6. Turn the engine on the work stand so that the bottom of the engine is up. Remove the oil pan, gaskets and seals. Remove the oil pump and inlet tube assembly. Discard the oil pump gasket.
7. **Make sure all bearing caps (main and connecting rod) are marked so that they can be installed in their original locations.** Turn the crankshaft until the connecting rod from which the cap is being removed is at the bottom of the stroke.

Remove the connecting rod cap and bearings. Push the connecting rod and piston assembly up in the cylinder. **Do not turn the crankshaft completely around as the rod bolts may damage the crankpin journals.** Repeat this procedure and remove all connecting rod caps.

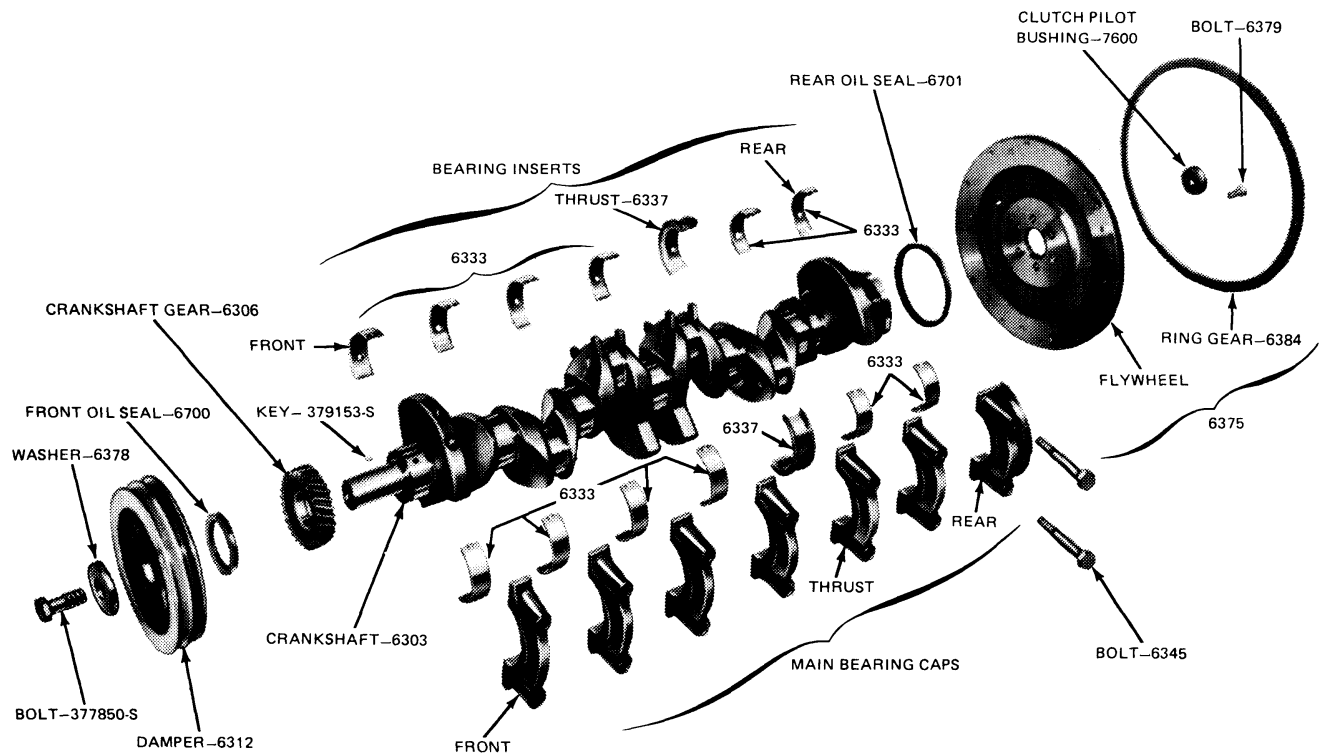
8. Remove the clutch pilot bearing if necessary.
9. Align the timing marks (Fig. 30). Remove the crankshaft gear (Fig. 34).
10. Remove the main bearing caps and bearings and rear bearing seal.
11. Carefully lift the crankshaft out of the cylinder block so that the thrust bearing surfaces are not damaged. **Handle the crankshaft with care to avoid possible fracture or damage to the finished surfaces.**

Refer to Part 21-01 for the cleaning and inspection procedures. Be sure the oil seal surfaces on the crankshaft and crankshaft damper are properly cleaned.

To refinish journals, dress minor imperfections, etc., refer to Part 21-01.

Installation

1. Remove the main bearing inserts from the block and bearing caps.
2. Remove the bearing inserts from the connecting rod caps.
3. Clean the crankshaft rear oil seal recess in the cylinder block and rear main bearing cap.
4. If the crankshaft main bearing journals have been refinished to a definite undersize, install the correct undersize bearings. Be sure the bearing inserts and bearing bores are clean. Foreign material under the inserts will distort the bearing and cause a failure.
5. Place the upper main bearing inserts in position in the bore with the tang fitting in the slot provided. Be sure the oil holes in the bearing inserts are aligned with the oil holes in the cylinder block.
6. Install the lower main bearing inserts in the bearing caps with the tang fitted in the slot.
7. Carefully lower the crankshaft into place. **Be careful not to damage the bearing surfaces.**
8. Check the clearance of each main bearing following procedures given in Part 21-01 under Fitting Main and Connecting Rod Bearings. Seal the rear main bearing-to-block mating surfaces as directed in Main Bearing Installation.
9. After the bearings have been installed, apply a light coat of heavy engine oil to the journals and bearings. Install all the bearing caps, except the thrust bearing cap (No. 5 bearing). **Be sure that the main bearing caps are installed in their original locations.** Tighten the bearing cap bolts to specifications.
10. Install the thrust bearing cap with the bolts finger-tight
11. Pry the crankshaft forward against the thrust surface of the upper half of the bearing (Fig. 42).
12. Hold the crankshaft forward and pry the thrust bearing cap to the rear. This will align the thrust surfaces of both halves of the bearing.



A2843-2A

FIG. 46 Crankshaft and Related Parts

13. Retain the forward pressure on the crankshaft. Tighten the cap bolts to specifications.
14. Check the crankshaft end play (refer to Part 21-01).
15. If the end play exceeds the service limit, replace the thrust bearing. If the end play is less than the minimum limit, inspect the thrust bearing faces for scratches, burrs, nicks or foreign matter. If the thrust faces are not damaged or dirty, they probably need re-aligning. Install the thrust bearing and align the faces following the recommended procedure (Steps 10 thru 13). Then check the end play.
16. Coat a new crankshaft rear oil seal with oil and install it (Fig. 44). Inspect the seal to be sure it was not damaged during installation.
17. Install the bearing inserts in the connecting rods and caps. Check the clearance of each bearing following the procedure under Connecting Rod Bearing Replacement.
18. If the bearing clearances are to specifications, apply a light coat of engine oil to the journals and bearing.
19. Turn the crankshaft throw to the bottom of its stroke and pull the piston all the way down until the connecting rod bearing seats on the crankshaft journal.
20. Install the connecting rod cap and tighten the nuts to specifications.
21. After the piston and connecting rod assemblies have been installed, check the connecting rod side clearance (refer to Specifications listed at the end of this Part) on each crankshaft journal (Fig. 41).
22. Clean the oil pan, oil pump and oil pump screen.
23. Install the inlet tube and screen on the oil pump. Prime the oil pump by filling the inlet opening with oil and rotate the pump shaft until oil emerges from the outlet opening. Install the oil pump. Tighten the attaching bolts to specifications.
24. On a crankshaft for a standard transmission, install the clutch pilot bearing refer to Clutch Pilot Bearing Removal and Installation.
25. Turn the engine on the work stand so that the rear of the engine is up. Position the engine rear cover plate on the cylinder block. Position the flywheel on the crankshaft. **Coat the threads of the attaching bolts with oil-resistant sealer and install the bolts.** Tighten the bolts to specifications.
On a flywheel for a manual-shift transmission, locate the clutch disc following the procedure in Group 16. Install the pressure plate. Tighten the attaching bolts to specifications.
26. Turn the engine on the work stand so that the front end is up.
27. Install the crankshaft gear following the procedure under Timing Gear Installation.
28. Install a new crankshaft front oil seal in the cylinder front cover (Fig. 23). Install the cylinder front cover and crankshaft damper by following the procedure outlined under Cylinder Front Cover Installation.
29. Apply oil-resistant sealer in the cavities between the bearing cap and cylinder block (Fig. 26). Install a new seal in the rear main bearing cap and apply a bead of oil-resistant sealer to the tapered ends of the seal. Install new side gaskets on the oil pan with oil-resistant sealer (Fig. 26). Position a new oil

pan to cylinder front cover seal on the oil pan and install the oil pan.

30. Install the oil level dipstick.
31. Remove the engine from the work stand and install it in the vehicle. Fill the crankcase and cooling system. Refer to Part 50-29, procedures A-1, A-4, A-5.
32. Start the engine and check all gaskets and hose connections for leaks.
33. Check the ignition timing and adjust the curb idle specifications on the engine decal.

CAMSHAFT BEARINGS

Camshaft bearings are available prefinished to size for standard and 0.015 inch undersize journal diameters.

Removal

1. Remove the engine following the procedures in this section and install in on a work stand (Fig. 39).
2. Remove the camshaft, flywheel and crankshaft, following the appropriate procedures. Push the pistons to the top of the cylinders.
3. Remove the camshaft rear bearing bore plug as detailed in Part 21-01. Remove the camshaft bearings with the tool shown in Fig. 47.
4. Select the proper size expanding collet and back-up nut and assemble on the expanding mandrel. With the expanding collet collapsed, install the collet assembly in the camshaft bearing and tighten the back-up nut on the expanding mandrel until the collet fits the camshaft bearing.
5. Assemble the puller screw and extension (if necessary) as shown and install on the expanding mandrel. Wrap a cloth around the threads of the puller screw to protect the front bearing or journal. Tighten the pulling nut against the thrust bearing and pulling plate to remove the camshaft bearing. Be sure to hold a wrench on the end of the puller screw to prevent it from turning.

6. To remove the front bearing, install the puller screw from the rear of the cylinder block.

Installation

1. Position the new bearings at the bearing bores, and press them in place with the tool shown in Fig. 47. Be sure to center the pulling plate and puller screw to avoid damage to the bearing. **Failure to use the correct expanding collet can cause severe bearing damage.** Align the oil holes in the bearings with the oil holes in the cylinder block before pressing bearings into place. **Be sure the front bearing is installed the specified distance below the front face of the cylinder block.**
2. Install the camshaft rear bearing bore plug as detailed in Part 21-01.
3. Install the camshaft, crankshaft, flywheel and related parts, following the appropriate procedures. Do not check connecting rod and main bearing clearances as a part of Camshaft Bearing Replacement.
4. Install the engine in the vehicle, following the procedures in this Part.

OIL FILTER

Removal

1. Place a drip pan under the oil filter. Unscrew the filter from the cylinder block with a filter wrench.

Installation

1. Coat the gasket on the filter with oil. Place the filter in position on the cylinder block. Hand-tighten the filter until the gasket contacts the adapter face, then advance it one-half turn.
2. Operate the engine at fast idle and check for oil leaks. If oil leaks are evident, perform the necessary repairs to correct the leakage. Check the oil level and fill the crankcase if necessary.

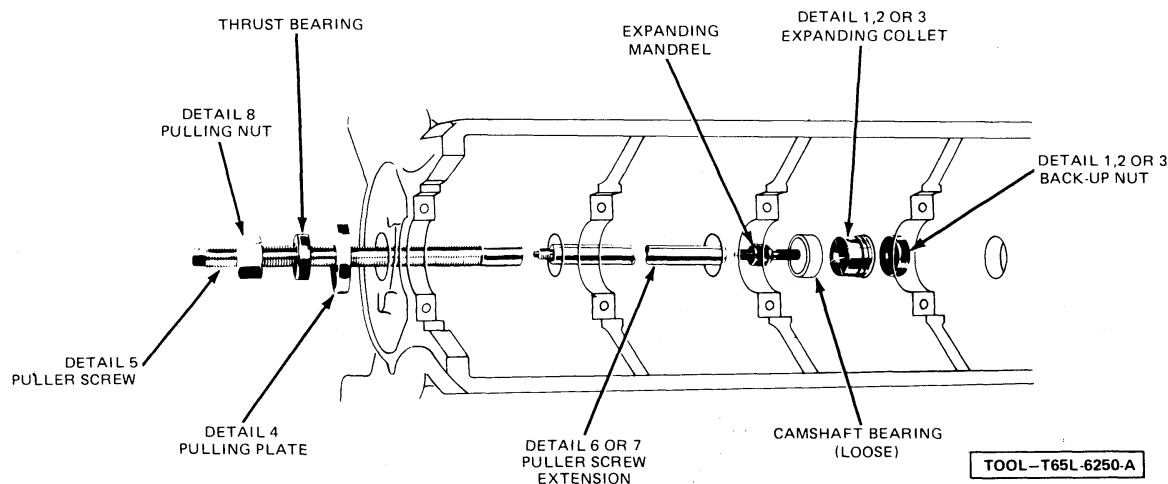


FIG. 47 Replacing Camshaft Bearing

DISASSEMBLY AND ASSEMBLY

When installing nuts or bolts that must be tightened (refer to torque specifications), oil the threads with light weight engine oil. **Do not oil threads that require oil-resistant or water-resistant sealer.**

CYLINDER HEAD

Disassembly

1. Remove the coolant outlet housing and thermostat. Discard the gasket.
2. Remove the intake manifold, exhaust manifold and carburetor as an assembly from the cylinder head. Discard the gasket.
3. Remove the spark plugs.
4. Remove the deposits from the combustion chambers and valve heads with a scraper and a wire brush before removing the valves. **Be careful not to scratch the cylinder head gasket surface.**
5. Compress the valve springs (Fig. 48), then remove the valve spring retainer locks and release the spring.

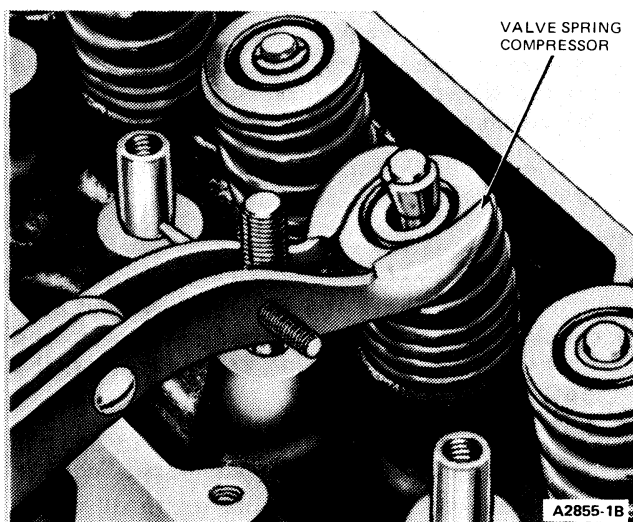


FIG. 48 Compressing Valve Spring on Bench

6. Remove the spring retainer, spring, stem seal and valve (Fig. 49). Discard the valve stem seals. Identify all valve parts.

Assembly

1. Lubricate the valve guides and valve stems with heavy engine oil. Apply Lubriplate or equivalent to the tip of the valve stems.
2. Install each valve in the valve guide from which it was removed or to which it was fitted.
3. Oil and install a new stem valve oil seal (Fig. 49).
4. Install the valve spring over the valve. **Be sure the closed coil end is placed against the cylinder head.**
5. Position the spring retainer on all valve springs. Make sure that a positive rotating retainer is used on all of the exhaust valves (Fig. 49).

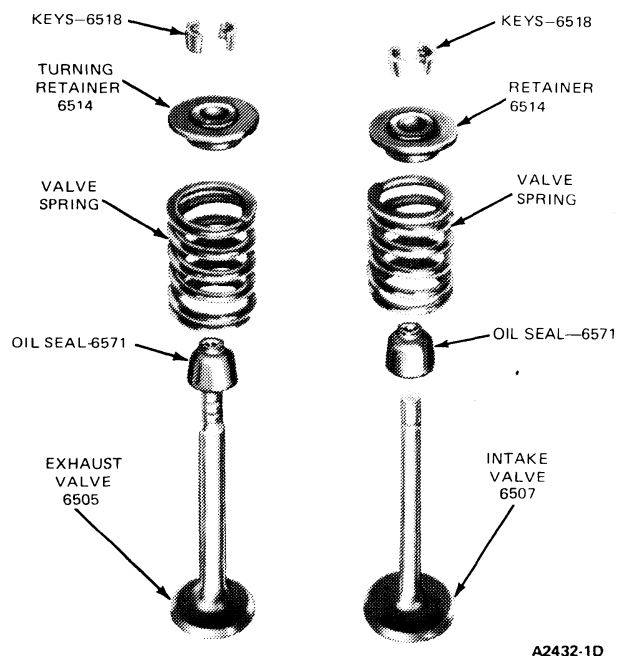


FIG. 49 Valve Assembly

6. Compress the spring (Fig. 48). Install the keys. Tap the retainers after assembly to seat the keys.
7. Measure the assembled height of the valve spring from the surface of the cylinder head spring pad to the underside of the spring retainer with dividers (Fig. 50).

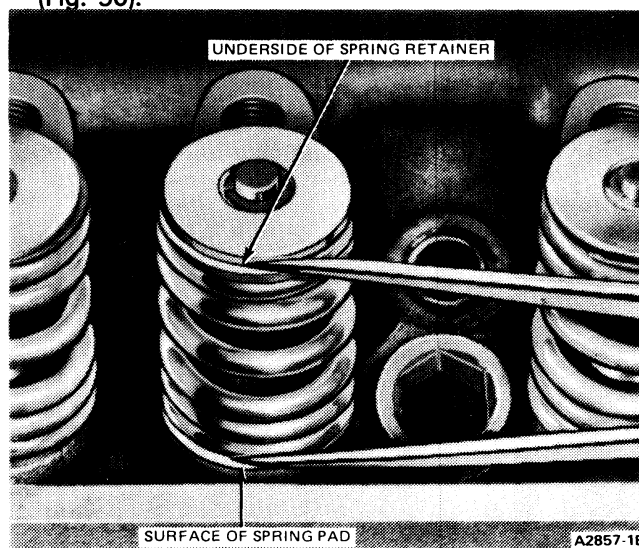


FIG. 50 Checking Valve Spring Assembled Height—Typical

Check the dividers against a scale. If the assembled height is greater than the specified limit, install the necessary 0.030 inch thick spacer(s) between the cylinder head spring pad and the valve spring to bring the assembled height to the recommended dimension. **Do not install spacers unless necessary. Use of spacers in excess of**

recommendations will result in overstressing the valve springs and overloading the camshaft lobes which could lead to spring breakage and worn camshaft lobes.

8. Position a new intake manifold gasket on the cylinder head. Install the intake manifold, exhaust manifold and carburetor as an assembly. Tighten the manifold bolts and nuts in sequence (Fig. 19) to specifications.
9. Using a new gasket coated with water-resistant sealer, install the thermostat and coolant outlet elbow as shown in Part 27-01. Tighten the attaching bolts to specifications.

VALVE LIFTER

Valve lifters should always be tested after assembly. Refer to the test procedures covered in Part 21-01.

Disassembly

Each valve lifter is a matched assembly. If the parts of one lifter are intermixed with those of another, improper valve operation may result. Disassemble and assemble each lifter separately. Keep the lifter assemblies in proper sequence so that they can be installed in their original bores.

1. Grasp the lock ring with needle nose pliers to release it from the groove. It may be necessary to depress the plunger to fully release the lock ring.
2. Remove the push rod cup, metering valve (disc), plunger and spring.
3. Invert the plunger assembly and remove the check valve retainer by carefully prying up on it with a screwdriver. Remove the check valve (disc or ball check) and spring.

For the cleaning and inspection procedures, refer to Part 21-01.

Assembly

Hydraulic valve lifter assembly is shown in Fig. 51.

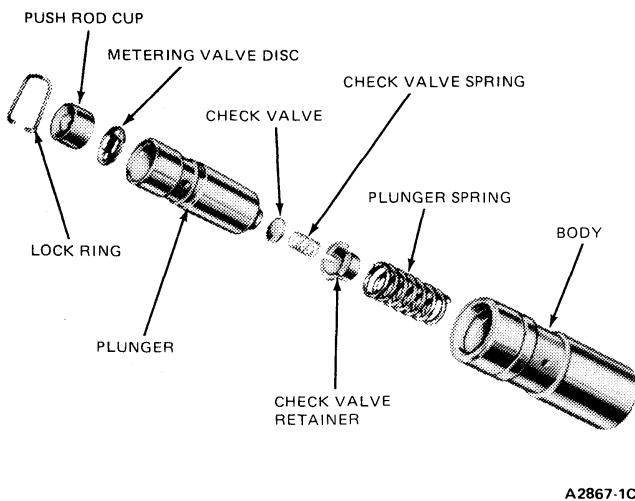


FIG. 51 Hydraulic Valve Lifter Assembly

1. Place the plunger upside down on a clean work bench.
2. Place the check valve (disc or ball check) in position

over the oil hole on the bottom of the plunger. Set the check valve spring on top of the check valve (disc or ball check).

3. Position the check valve retainer over the check valve and spring and push the retainer down into place on the plunger.
4. Place the plunger spring and then the plunger (open end up) into the lifter body.
5. Position the metering valve (disc) in the plunger and then place the push rod seat in the plunger.
6. Depress the plunger and position the closed end of the lock ring in the groove of the lifter body. With the plunger still depressed, position the open ends of the lock ring in the groove. Release the plunger and then depress it again to fully seat the lock ring.
7. Use the hydraulic valve lifter leakdown tester (Part 21-01) to fill the lifters with test fluid.

PISTON AND CONNECTING ROD

Disassembly

1. Remove the bearing inserts from the connecting rod and cap.
2. Mark the pistons and pins to assure assembly with the same rod and installation in the same cylinder from which they were removed.
3. Remove the piston rings. Using an Arbor Press and the tool shown in Fig. 52, press the piston pin from the piston and connecting rod.

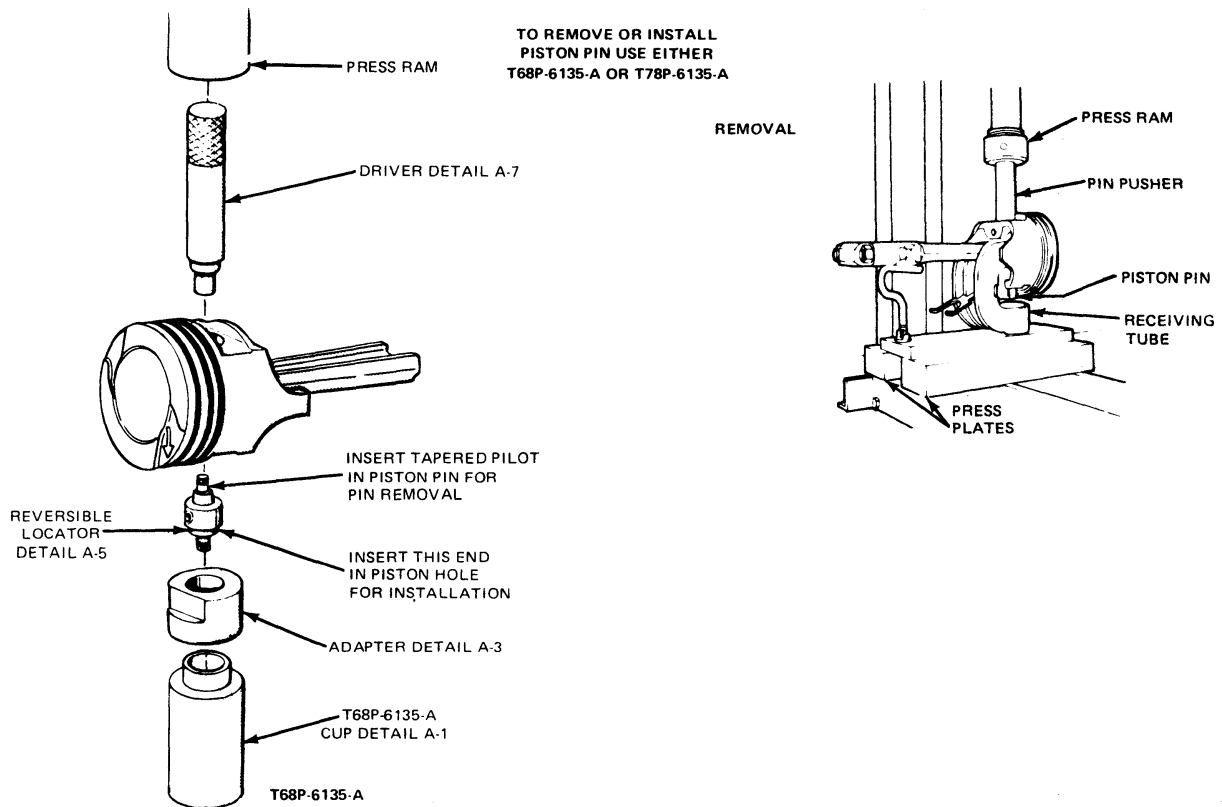
Refer to Part 21-01 for the Cleaning, Inspection and Repair procedures.

Assembly

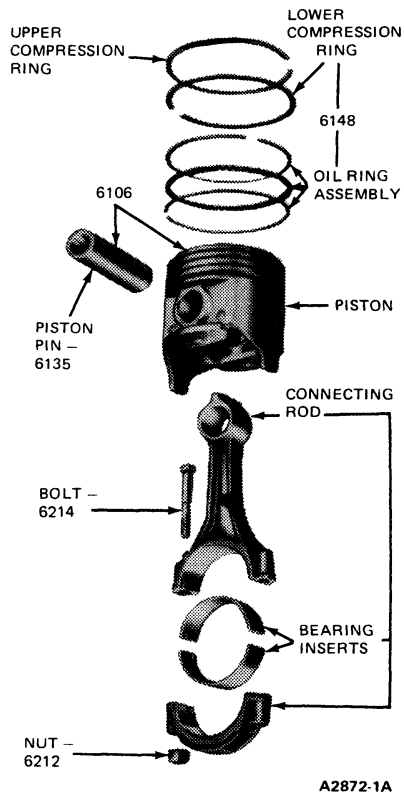
The piston, connecting rod and related parts are shown in Fig. 53. **Check the fit of a new piston in the cylinder bore before assembling the piston and piston pin to the connecting rod following the procedures in Part 21-01.**

The piston pin bore of a connecting rod and the diameter of the piston pin must be within specifications.

1. Apply a light coat of engine oil to all parts. **Assemble the piston to the connecting rod with the bearing tang side of the connecting rod and the indentation notch in the piston positioned as shown in Fig. 54.**
2. Start the piston pin in the piston and connecting rod. Using an Arbor Press, press the piston pin through the piston and connecting rod until the pin is centered in the connecting rod (Fig. 55). To install piston pin use either T68P-6135-A or T78P6135-A or equivalent.
3. Check the end gap of all piston rings (Part 21-01). It must be within specifications listed at end of this Part. Follow the instructions contained on the piston ring package and install the piston rings.
4. Check the ring side clearance of the compression rings with a feeler gauge inserted between the ring and its lower land (Part 21-01). The gauge should slide freely around the entire ring circumference without binding. Any wear that occurs will form a step at the inner portion of the lower land. **If the lower lands have steps, the piston should be replaced.**



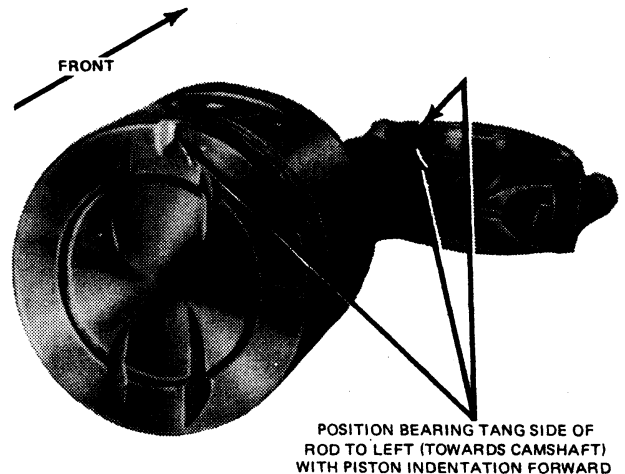
A4871-2B

FIG. 52 Removing Piston Pin

A2872-1A

FIG. 53 Piston, Connecting Rod and Related Parts

5. Be sure the bearing inserts and the bearing bore in the connecting rod and cap are clean. Foreign



A2185-1B

FIG. 54 Oil Hole Position

material under the inserts will distort the bearing and cause a failure. Install the bearing inserts in the connecting rod and cap with the tangs fitting in the slots provided.

CYLINDER BLOCK—6010

Before replacing a cylinder block, determine if it is repairable. If so, make the necessary repairs, following the procedures given in Part 21-01.

Disassembly

1. Mount the old engine in a work stand and completely disassemble it, removing the cylinder

head and manifolds as an assembly. Follow the procedures given in the Removal and Installation Section of this Part.

2. Remember to ridge-ream the cylinder bores before removing the piston assemblies.
3. Remove the cylinder head locating dowels and block drain plugs.

Assembly

1. Clean the gasket and seal surfaces of all serviceable parts and assemblies.
2. Position the new cylinder block in the work stand and transfer all serviceable parts removed from the old cylinder block, following the instructions given in the Removal and Installation Section of this Part.
3. Install the cylinder head locating dowels and block drain plugs.
4. Check all assembly clearances and correct as necessary.

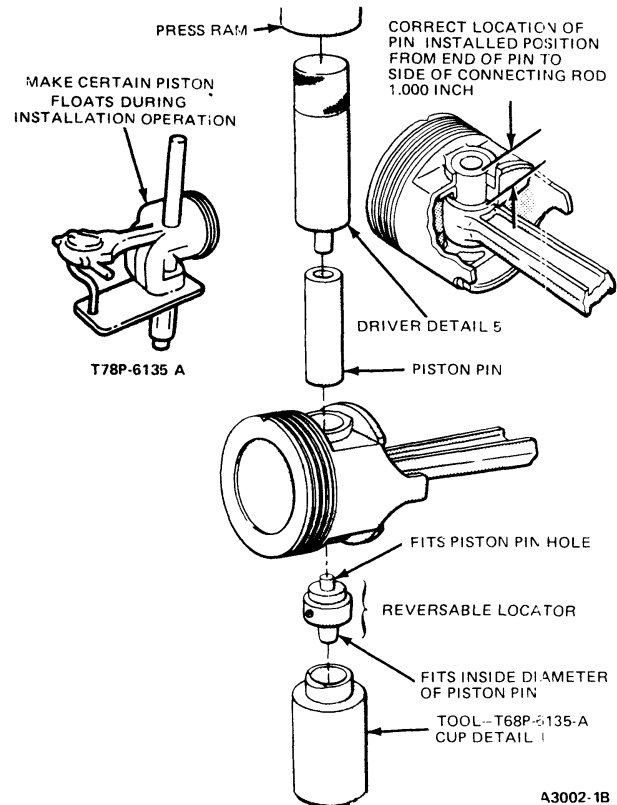
CYLINDER ASSEMBLY—6009

Disassembly

1. Mount the old engine in a work stand and remove all serviceable parts not furnished with the new cylinder assembly, including the cylinder block drain plugs and cylinder head locating dowels.
2. Remove the cylinder head and manifolds as an assembly.

Assembly

1. Clean the gasket and seal surfaces of all serviceable parts and assemblies.
2. Position the new cylinder assembly in a work stand and transfer all serviceable parts removed from the old cylinder assembly, following the instructions given in the Removal and Installation section of this Part.



A3002-1B

FIG. 55 Installing Piston Pin

3. Install the cylinder head locating dowels and block drain plugs.
4. Check all assembly clearances and correct as necessary.

CLEANING AND INSPECTION

Refer to Cleaning and Inspection Procedures in Part 21-01, General Gasoline Engine Service.

SPECIFICATIONS

GENERAL SPECIFICATIONS

Engine	Bore and Stroke	Firing Order	Oil Pressure Hot @ 2000 RPM kPa (PSI)	Engine Type and Number of Cylinders	Belt Tension — Lb. ①
4.9L (300 CID) I-6	4.00 x 3.98	153624	275 (40-60)	O.H.V. I-6	—

①

Belt Size	Newly Installed ②	Used less than 10 min.	Used over 10 min.
All except ¼"	534-711N (120-160 lbs.)	400-711N (90-160 lbs.) ③	334-533N (75-120 lbs.) ④
¼" Only	223-355N (50-80 lbs.)	178-355N (40-80 lbs.) ③	178-266N (40-60 lbs.) ③

② Tension measured immediately after belt is installed and before it is stretched or seats in pulley grooves.

③ If less than 90 lbs., readjust to 90-120 lbs.

④ If less than 40 lbs., readjust to 40-60 lbs.

⑤ If less than 75 lbs., readjust to 90-120 lbs.

CYLINDER HEAD

Engine	Combustion Chamber Volume C.C. ③	Valve Guide Bore Diameter		Valve Seat Width ①		Valve Seat Runout TIR Maximum	Valve Arrangement Front to Rear	Gasket Surface Flatness ②	Rocker Arm Stud Bore Diameter Std. ①
		Intake	Exhaust	Intake	Exhaust				
4.9L (300 CID) I-6	76.0- 79.0	.3433- .3443	.3433- .3443	.060- .080	.070- .090	.002	E-I-E-I-E-I- E-I-E-I-E-I	.006 in any 6 in. .007 overall	.3685- .3695

① Valve seat angle — 45°.

② Gasket surface finish — RMS 60-150.

③ Compression pressure (PSI) of the lowest cylinder must be at least 75% of the highest to be within specification.

VALVE ROCKER ARM SHAFT, PUSH RODS AND TAPPETS

Engine	Rocker Arm Lift Ratio to 1	Push Rod Runout TIR Maximum	Valve Tappet or Lifter			Collapsed Tappet Gap (Clearance)	
			Standard Diameter	Clearance to Bore ①	Hydraulic Lifter Leakdown Rate ②	Allowable	Desired
4.9L (300 CID) I-6	1.62	.015	.8740-.8745	.0007-.0027	10 to 50 seconds for 1/16 travel	.100-.200	.125-.175

① Service limit — .005.

② Time required for plunger to leakdown .0625 under load of 50 lbs. using leakdown fluid in tappet.

VALVE SPRINGS

Engine	Valve Spring Compression Pressure Lbs. @ Specified Height		Valve Spring Free Length (Approximate)		Valve Spring Assembled Height ②		Valve Spring Out Of Square
	Intake ①	Exhaust	Intake	Exhaust	Intake	Exhaust	Maximum
4.9L (300 CID) I-6	76-84 @ 1.700 187-207 @ 1.300	77-85 @ 1.580 182-202 @ 1.180	1.99	1.87	1-11/16 — 1-23/32	1-9/16 — 1-19/32	5/64 (.078)

① Service limit — 10% loss of pressure.

② Pad to retainer.

VALVES

Engine	Valve Stem to Guide Clearance ①		Valve Head Diameter ②		Valve Face Runout TIR Maximum
	Intake	Exhaust	Intake	Exhaust	
4.9L (300 CID) I-6	.0010-.0027	.0010-.0027	1.772-1.790	1.551-1.569	.0020

① Service clearance — .0055 Maximum.

② Valve face angle — 44°.

VALVES (Continued)

Engine	Valve Stem Diameter					
	Standard		.015 Oversize		.030 Oversize	
	Intake	Exhaust	Intake	Exhaust	Intake	Exhaust
4.9L (300 CID) I-6	.3416-	.3416-	.3566-	.3566-	.3716-	.3716-
	.3423	.3423	.3573	.3573	.3723	.3723

CAMSHAFT

Engine	Lobe Lift ¹		Camshaft End Play		Camshaft Journal To Bearing Clearance ²
	Intake	Exhaust	End Play	Service Limit	
4.9L (300 CID) I-6	.249	.249	.001-.007	.009	.001-.003

¹Maximum allowable lift loss — .005.

²Service clearance — .006.

CAMSHAFT DRIVE

Engine	Camshaft Journal Diameter — Standard ^①				Camshaft Bearing Inside Diameter				Camshaft Front Bearing Location ^②	Assembled Gear Face Runout ^③	
	No. 1	No. 2	No. 3	No. 4	No. 1	No. 2	No. 3	No. 4		Crankshaft	Camshaft
4.9L (300 CID) I-6	2.017-	2.017-	2.017-	2.017-	2.019-	2.019-	2.019-	2.019-	.020-.035	.005	.005
	2.018	2.018	2.018	2.018	2.020	2.020	2.020	2.020			

^① Camshaft journal runout — .008 TIR maximum.

^② Distance in inches that front edge of the bearing is installed below the front face of the cylinder block.

^③ Gear backlash — .002-.004.

CYLINDER BLOCK

Engine	Cylinder Bore Diameter ^①	Main Bearing Bore Diameter ^②	Distributor Shaft Bearing Bore Diameter	Head Gasket Surface Flatness	Head Gasket Surface Finish	Tappet Bore Diameter
4.9L (300 CID) I-6	4.0000-	2.5902-	.5155-	.003 in any 6 in.	RMS	.8752-
	4.0048	2.5910	.5165	.006 overall	60-150	.8767

^① Maximum out-of-round .0015, Service limit — .005, Maximum taper service limit — .010, Cylinder bore surface finish RMS 18-38, Bore taper service limit — .010

^② Crankshaft to rear face of block runout: TIR maximum .005

CRANKSHAFT AND FLYWHEEL

Engine	Main Bearing Journal Diameter ^①	Main Bearing Journal Runout TIR Maximum ^②	Main Bearing Thrust Face Runout TIR Maximum	Main Bearing Journal Taper Maximum Per Inch	Thrust Bearing Journal Length	Main and Rod Bearing Journal Finish RMS Maximum	Main Bearing Thrust Face Finish RMS Maximum
4.9L (300 CID) I-6	2.3982-2.3990	.002	.001	.0005	1.1990-1.2010	12	35 Front — 25 Rear

^① Maximum out-of-round — .0006.

^② Service limit — .005.

CRANKSHAFT AND FLYWHEEL (Continued)

Engine	Connecting Rod Journal Diameter ^①	Connecting Rod Journal Taper Per Inch Maximum	Crankshaft Free End Play ^②	Flywheel Clutch Face Runout Assembled	Flywheel Ring Gear Lateral Runout TIR	
					Std. Trans.	Auto. Trans.
4.9L (300 CID) I-6	2.1228-2.1236	.0006	.004-.008	.010	.040	.060

^① Maximum out-of-round — .0006.

^② Service limit — .012.

CRANKSHAFT BEARINGS

Engine	Connecting Rod Bearing to Crankshaft Clearance Selective Fit			Main Bearing to Crankshaft Clearance Selective Fit		
	Desired	Allowable	Bearing Wall Thickness Std. ①	Desired	Allowable	Bearing Wall Thickness Std. ①
4.9L (300 CID) I-6	.0008-.0015	.0007-.0024	.0752-.0757	.0008-.0015	.0010-.0028	.0951-.0956

① For .002 undersize add .001 to standard wall thickness.

CONNECTING ROD

Engine	Piston Pin Bore or Bushing I.D.	Rod Bearing Bore I.D. ①	Rod Length Center to Center	Connecting Rod Alignment Maximum Total Difference		Rod to Crankshaft Assembled Side Clearance ②
				Twist ③	Bend ③	
4.9L (300 CID) I-6	.9734-.9742	2.2750-2.2758	6.2082-6.2112	.024	.012	.006-.013

① Connecting rod bearing bore maximum out-of-round — .0006.

② Pin bushing and crankshaft bore must be parallel and in same vertical plane within specified total difference when measured at the ends of an 8-inch long bar, 4 inches on each side of rod centerline.

③ Service limit — .018.

PISTON

Engine	Diameter ①			Piston to Bore Clearance Selective Fit	Piston Pin Bore Diameter	Ring Groove Width Compression		
	Coded Red	Coded Blue	.003 Oversize			Top	Bottom	Oil
4.9L (300 CID) I-6 ②	3.9982-3.9988	3.9994-4.0000	4.0008-4.0014	.0014-.0022	.9754-.9757	.080-.081	.080-.081	.188-.189

① Measured at the piston pin bore centerline at 90° to the pin.

② Over 8500 Lbs. GVW.

PISTON PIN

Engine	Length	Diameter			To Piston Pin Bore Clearance ①	To Connecting Rod Bushing Clearance
		Standard	.001 Oversize	.002 Oversize		
4.9L (300 CID) I-6	3.150-3.170	.9749-.9754	.9760-.9763	.9770-.9773	.0002-.0004 ②	Interference Fit

① Selective Fit.

② Under 8500 Lbs. GVW — .0003-.0005

PISTON RINGS

Engine	Ring Width Compression		Side Clearance Compression ①			Ring Gap Compression		
	Top	Bottom	Top	Bottom	Oil	Top	Bottom	Oil ②
4.9L (300 CID) I-6	.0774-.0781	.0770-.0780	.0019-.0036	.002-.004	Snug	.010-.020	.010-.020	.010-.035

① Service limit — .002 maximum increase in clearance.

② Steel rail.

OIL PUMP AND OIL CAPACITY

Engine	Relief Valve Spring Pressure Lbs. @ Specified Length	Driveshaft to Housing Clearance	Relief Valve to Housing Clearance	Rotor Assembly End Clearance	Outer Race to Housing Clearance	Engine Oil Capacity Qts. — U.S. 1
4.9L (300 CID) I-6	20.6-22.6 @ 2.49	.0015-.0030	.0015-.0030	.004 Maximum	.001-.013	5

① Add 1 qt. when replacing filter. Refer to Part 50-29, Procedure A-1.

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FUEL PUMP — MECHANICAL

Engine	Static Pressure (PSI) ①	Volume Flow — Minimum ① ②	Eccentric Total Lift — Inches
4.9L (300 CID) I-6	5.0-7.0	.23L (1 pint) in 20 seconds	.290-.310

① On the engine with temperatures normalized and at normal curb idle speed, in neutral.

② The inside diameter of the smallest passage in the test flow circuit must not be less than .220.

TORQUE LIMITS — 4.9L (300 CID) I-6 ENGINE

NOTE: All values are in N•m (ft-lbs) unless otherwise noted. Oil threads with engine oil unless the threads require oil or water-resistant sealer. The standard torque limits listed below are applicable for all functions not listed in the special torque chart.

1/4-20	5/16-18	5/16-24	3/8-16	3/8-24	7/16-14	7/16-20	1/2-13	9/16-18
8-12 (6-9)	17-24 (12-18)	19-27 (14-20)	30-43 (22-32)	37-51 (27-38)	61-77 (45-57)	55-81 (40-60)	75-81 (55-60)	116-162 (85-120)

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PIPE THREADS

1/8-27	1/4-18	3/8-18	1/2-14
7-11 (5-8)	17-24 (12-18)	30-44 (22-33)	34-47 (25-35)

TORQUE SPECIFICATIONS

Item	Torque N•m (ft-lbs)
Connecting Rod Nut	55-61 (40-45)
Cylinder Front Cover	17-24 (12-18)
Cylinder Head Bolts	①
Damper to Crankshaft	177-203 (130-150)
EGR Valve to Carburetor Spacer or Intake Manifold	17-24 (12-18)
Flywheel to Crankshaft	102-115 (75-85)
Main Bearing Cap Bolts	82-94 (60-70)
Manifold to Cylinder Head — Intake	30-43 (22-32)
Manifold to Cylinder Head — Exhaust	38-44 (28-33)
Oil Filter Insert to Cylinder Block/Adaptor	28-40 (20-30)
Oil Filter Adaptor to Cylinder Block	55-67 (40-50)
Oil Filter to Adaptor or Cylinder Block	½ turn after gasket contacts sealing surface — oiled gasket
Oil Inlet Tube to Pump	14-20 (10-15)
Oil Pan Drain Plug	21-33 (15-25)
Oil Pan to Cylinder Block	14-20 (10-15)
Oil Pump to Cylinder Block	14-20 (10-15)
Oil Inlet Tube to Main Bearing Cap	30-43 (22-32)
Pulley to Damper Bolt	48-67 (35-50)
Rocker Arm Stud Nut	24-31 (17-23)
Spark Plug to Cylinder Head	14-20 (10-15)
Valve Rocker Arm Cover	5-9 (4-7)
Valve Push Rod — Cover to Cylinder Block	1.7-2.25 (15-20 in-lbs)
Water Outlet Housing	17-24 (12-18)
Water Pump to Block/Front Cover	17-24 (12-18)
Alternator Bracket to Cylinder Block — Bolt	41-61 (30-45)
Alternator Adjusting Arm to Cylinder Block Bolt	26-36 (19-27)
Alternator Adjusting Arm to Alternator Bolt	33-54 (24-40)
Thermactor Pump Pivot Bolt	41-48 (30-35)
Thermactor Pump Adjusting Arm to Pump	30-43 (22-32)
Thermactor Pump Pulley to Pump Hub	17-24 (150-220 in-lbs)
Thermactor Pump Bracket to Cylinder Block	30-43 (22-32)
Fuel Filter to Carburetor/Pump	10-11 (80-100 in-lbs)
Carburetor Attaching Nuts	17-20 (12-15)
Camshaft Thrust Plate to Cylinder Block	13-16 (9-12)
Fuel Pump to Cylinder Block/Front Cover	17-24 (12-18)
Carburetor Mounting Stud	7-13 (5-10)
Distributor Clampdown	24-33 (17-25)
Intake Manifold Vacuum Fittings	8-13 (6-10)

① Torque in steps; first to 75 (55); then to 88 (65); final to 115 (85).

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5.0L (302 CID) V-8 and 5.8L (351 CID) W-V-8 Engines		PART 21-21	
APPLIES TO ALL MODELS			
SUBJECT		PAGE	
SUBJECT		PAGE	
ADJUSTMENTS		REMOVAL AND INSTALLATION (Cont'd.)	
Valve Clearance		Crankshaft	21-21-30
5.0L (302 CID) V-8 Engine	21-21-6	Crankshaft Rear Oil Seal	21-21-27
5.8L (351 CID) W-V-8 Engine	21-21-7	Cylinder Front Cover and	
DESCRIPTION		Timing Chain	21-21-20
Cooling System	21-21-1	Cylinder Heads	21-21-18
Crankcase Ventilation System	21-21-6	Engine Assembly	
Engine	21-21-1	E-100 — E-250	21-21-9
Exhaust Emission Control System	21-21-6	F-100 — E-250	21-21-8
Lubrication System	21-21-1	Engine Front Supports	21-21-11
DIAGNOSIS & TESTING	21-21-6	Engine Rear Supports	21-21-11
DISASSEMBLY AND ASSEMBLY		Exhaust Manifolds	21-21-19
Cylinder Assembly — (6009)	21-21-36	Flywheel	21-21-24
Cylinder Block — (6010)	21-21-36	Front Oil Seal	21-21-23
Cylinder Heads	21-21-33	Intake Manifold	21-21-15
Oil Pump	21-21-34	Main Bearing	21-21-27
Pistons and Connecting Rods	21-21-35	Oil Filter	21-21-32
Tappet	21-21-33	Oil Pan	21-21-25
REMOVAL AND INSTALLATION		Oil Pump	21-21-26
Camshaft	21-21-23	Pistons and Connecting Rods	21-21-28
Camshaft Bearings	21-21-32	Tappet	21-21-17
Camshaft Rear Bearing Bore Plug	21-21-25	Valve Rocker Arm Cover and	
Clutch Pilot Bearings	21-21-24	Rocker Arm	21-21-14
Connecting Rod Bearings	21-21-28	Valve Spring, Retainer and Stem	
Crankcase Ventilation System		Seal	21-21-15
E-100 — E-250	21-21-13	Water Pump	21-21-20
F-100 and E-250	21-21-12	SPECIFICATIONS	21-21-37

DESCRIPTION

ENGINE

The 5.0L (302 CID) V-8 and 5.8L (351 CID) W-V-8 engines have the same basic design. The cylinder block for these engines is special high grade cast iron, thin wall construction. The crankshaft has five main bearings and is precision cast nodular iron. Pistons are aluminum alloy, tin plated. Valve rocker arms are individually bolt mounted. The valve lifters are hydraulic.

The 5.0L (302 CID) V-8 is used as an option on some F-100, F-150, F-250 and Bronco models, also E-100, E-150 and E-250. The 5.8L (351 CID) W-V-8 is used primarily as an optional engine for E-100—E-250 all models. An aluminum intake manifold is used on 5.0L

(302 CID) and 5.8L (351 CID) W-V-8 engines. Refer to the Specification listed at the end of this Part.

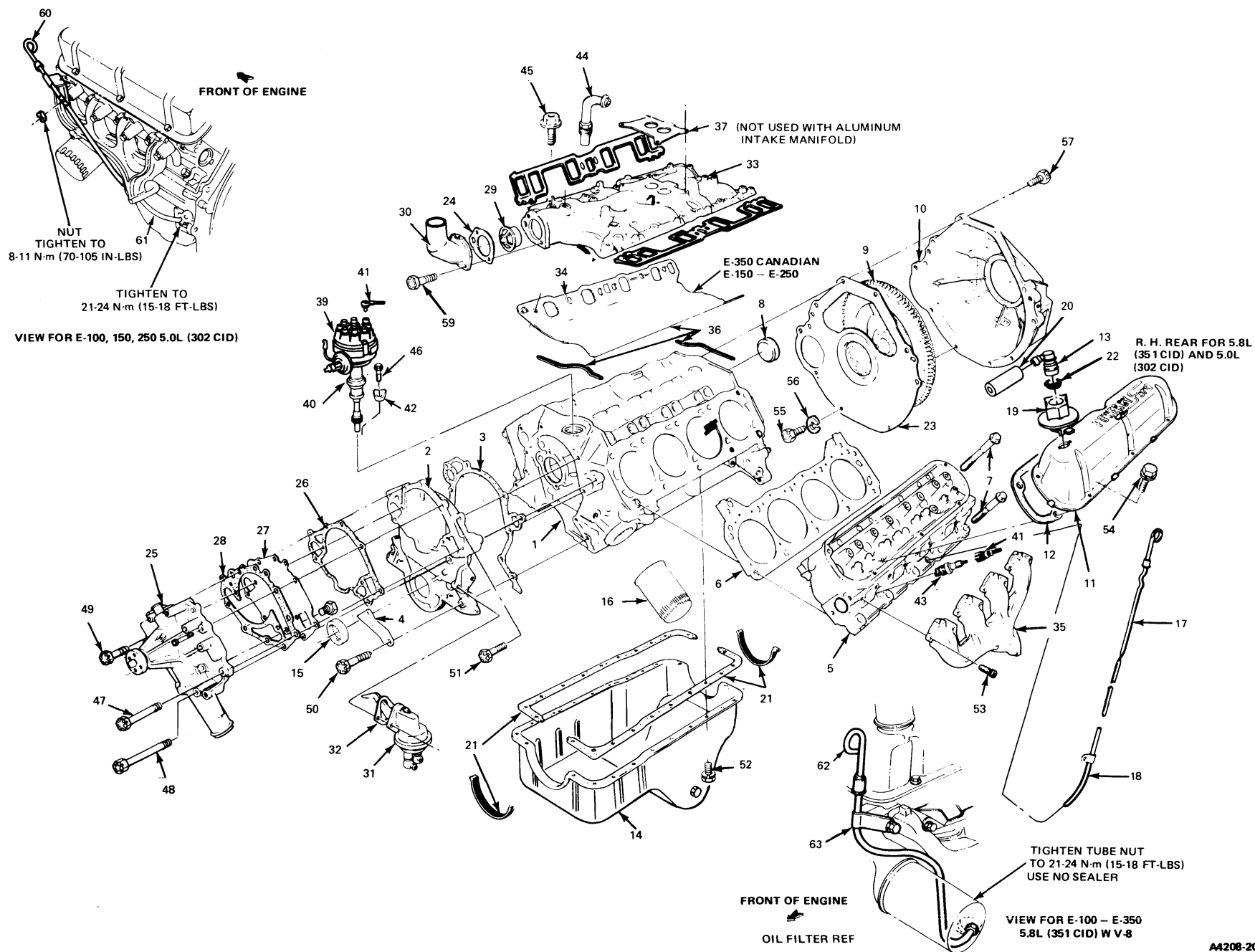
The illustrations shown in Figs. 1 and 2 are typical and will serve as a reference for the procedures outlined. The numbers and part descriptions shown in the illustration keys are basic part numbers corresponding with the Ford Master Parts Catalog.

LUBRICATION SYSTEM

A typical lubrication system is shown in Figure 3.

COOLING SYSTEM

A typical cooling system is shown in Figure 4.



A4208-2C

REF. NO.	BASIC PART NO.	DESCRIPTION	REF. NO.	BASIC PART NO.	DESCRIPTION	REF. NO.	BASIC PART NO.	DESCRIPTION
1	6009	Cylinder Assy. — (Includes internal parts)	39	12106	Distributor — Parts			
2	6019	Cover Assy. — Cylinder Front	40	12127	Distributor Assy.			
3	6020	Gasket — Cylinder Front Cover	41	12259	Wire Set — Spark Plug			
4	6023	Pointer — Timing	42	12270	Clamp — Distributor			
5	6049	Head — Cylinder	43	12405	Spark Plug Assy.			
6	6051	Gasket — Cylinder Head	44	18599	Elbow — Hot Water Connection			
7	6065	Bolt — Cylinder Head	45	56126-S	Bolt — Washer Head — 5/16-18 x 7/8"			
8	6266	Plug — Camshaft Rear Bearing	46	20386-S	Bolt — 5/16-18 x 1"			
9	6375	Flywheel Assy.	47	383765-S	Bolt — 5/16-18 x 3-5/8"			
10	6392	Housing Assy. — Flywheel	48	300958-S	Bolt — 5/16-18 x 5"			
11	6582	Cover Assy. — Valve Rocker Arm	49	56128-S	Bolt — 5/16-18 x 2-1/2"			
12	6584	Gasket — Valve Rocker Arm Cover	50	56126-S	Bolt — 5/16-18 x 2"			
13	6B890	Elbow & Valve Assy. — Positive Crankcase Ventilation (P.C.V.)	51	376256-S	Bolt or Screw — 5/16-18 x 1"			
14	6675	Pan Assy. — Oil	52	373564-S	Bolt — 5/16-18 x 1-7/8"			
15	6700	Seal — Cylinder Front Cover	53	381731-S	Bolt — 3/8-16 x 1-7/8"			
16	6731	Element Assy. — Oil Filter	54	356748-S	Bolt — 1/4-20 x 5/8"			
17	6750	Indicator — Oil Level	55	20346-S	Bolt — 5/16-18 x 3/4" - 17-24 N·m (12-18 FT-LBS)			
18	6754	Tube Assy. — Oil Level Indicator	56	34806-S	Washer — Lock — 5/16 x 19/32 x 5/64"			
19	6766	Cap Assy. — Oil Filler	57	20508-S	Bolt — 7/16-14 x 1-3/4"			
20	381187	Hose — Positive Crankcase Ventilation	58	34808-S	Washer — Lock — 7/16"			
21	6781	Gasket Set — Oil Pan	59		Bolt — 5/16-18			
22	6A892	Retainer — Crankcase Ventilation — Grommet	60	6750-CA	Indicator — Oil Level			
23	7007	Plate Assy. — Engine Rear	61	6754-CA	Tube Assy. — Oil Level Indicator			
24	8255	Gasket — Water Outlet Connection	62	6750-BA	Indicator — Oil Level			
25	8501	Pump Assy. — Water	63	6754-AC	Tube Assy. — Oil Level Indicator			
26	8507	Gasket — Water Pump Housing						
27	8508	Cover — Water Pump						
28	8513	Gasket — Water Pump Cover	64	9441	Gasket Intake Manifold			
29	8575	Thermostat — Water						
30	8592	Connection — Water Outlet						
31	9350	Pump Assy. — Fuel						
32	9417	Gasket — Fuel Pump Mounting						
33	9424	Manifold — Intake						
34		Intake Manifold Gasket — Intake Manifold to Cylinder Block						
35	9430	Manifold — Exhaust						
36	9433	Gasket Set — Manifold						
37	9447	Gasket — Carburetor						

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FIG. 1 External Exploded View—Key

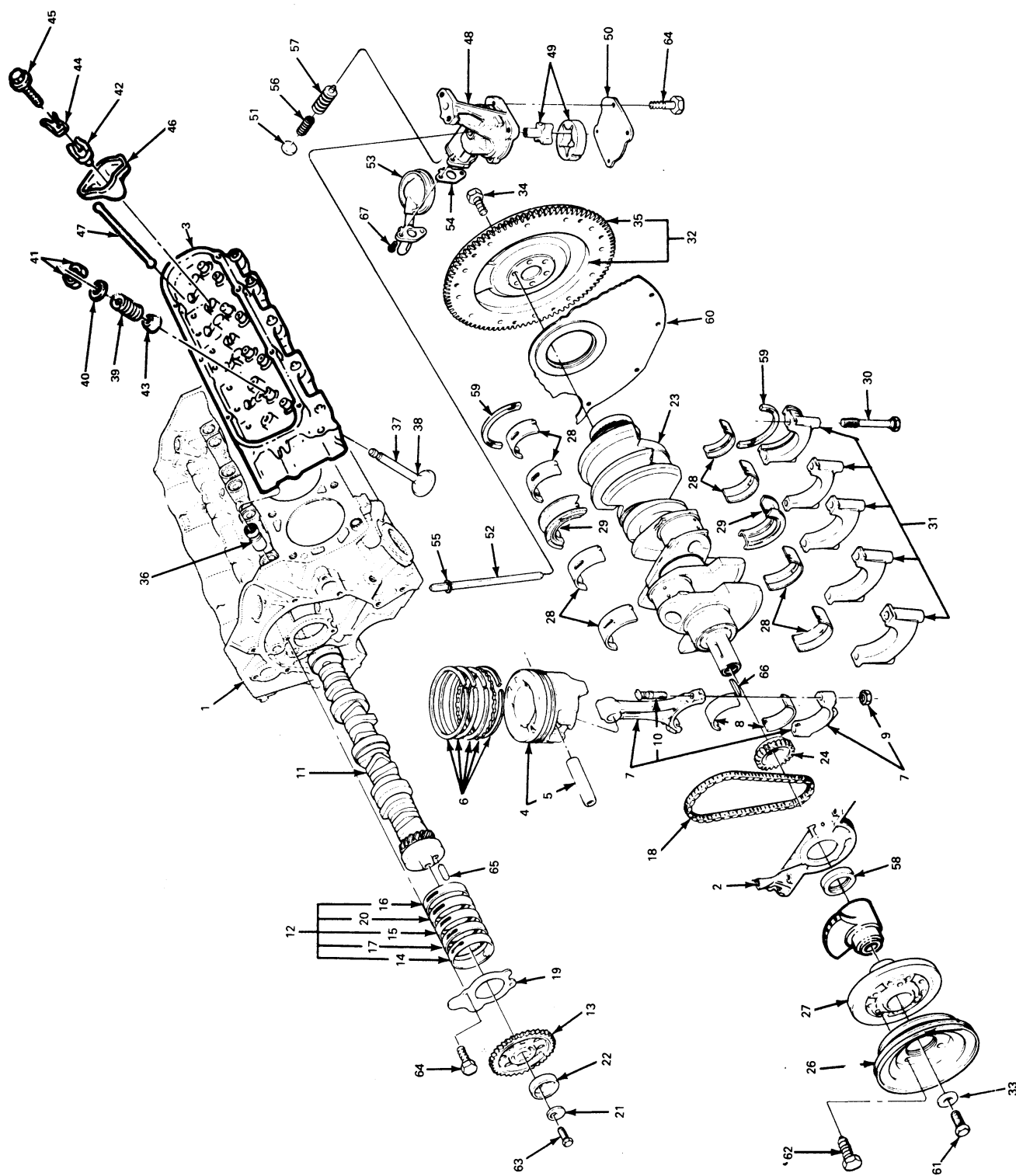
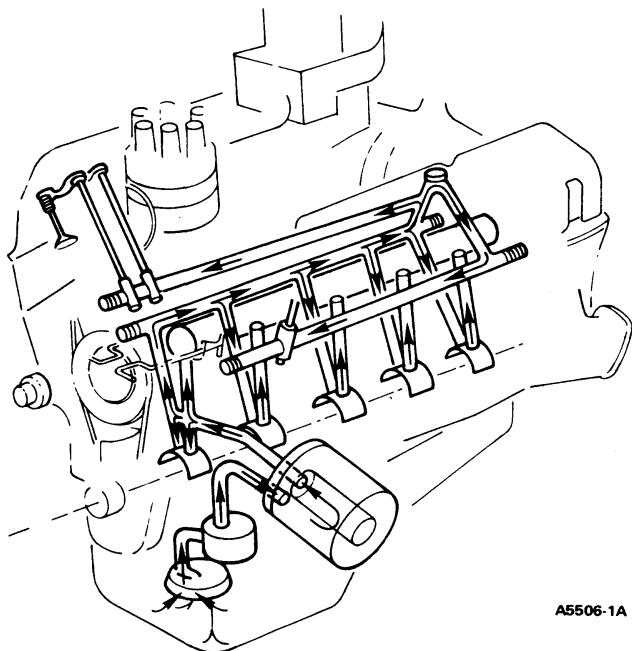


FIG. 2 Internal Exploded View—5.0L (302 CID) V-8 and 5.8L (351 CID) W-V-8 Engines

Ref. No.	Basic Part No.	Description	Ref. No.	Basic Part No.	Description
1	6010	Block Assy. (Internal parts not included)	34	6379	Bolt — Flywheel to Crankshaft
2	6019	Cover Assy. — Cylinder Front	35	6384	Gear — Flywheel Ring
3	6049	Head — Cylinder	36	6500	Tappet Assy. — Hydraulic
4	6108	Piston Assy.	37	6505	Valve — Exhaust
5	6135	Pin — Piston	38	6507	Valve — Intake
6	6148	Ring Set — Piston	39	6513	Spring — Valve
7	6200	Rod Assy. — Connecting	40	6514	Retainer — Valve Spring
8	6211	Bearing — Connecting Rod	41	6518	Key — Valve Spring Retainer
9	6212	Nut — Connecting Rod	42	6A528-A	Fulcrum
10	6214	Bolt — Connecting Rod	43		Valve Stem Seal
11	6250	Camshaft	44	6A53-1	Oil Deflector
12	6251	Bearing Kit — Camshaft — Standard	45	6A527-A	Bolt — Rocker Arm Attach
13	6256	Sprocket — Camshaft (Nylon)	46	6564	Arm — Valve Rocker
14	6261	Bearing — Camshaft Front	47	6565	Rod — Valve Push
15	6262	Bearing — Camshaft Center	48	6600	Pump Assy. — Oil
16	6263	Bearing — Camshaft Rear	49	6608	Rotor and Shaft Assy. — Oil
17	6267	Bearing — Camshaft Front Intermediate	50	6616	Pump Drive
18	6268	Chain — Timing	51	6A616	Plate — Oil Pump Body
19	6269	Plate — Camshaft Thrust	52	6A618	Plug — Oil Pump Relief Valve
20	6270	Bearing — Camshaft Rear Intermediate	53	6622	Shaft Assy. — Oil Pump Intermediate
21	6278	Washer — Camshaft Sprocket	54	6626	Screen, Tube and Cover Assy. — Oil Pump
22	6287	Eccentric — Camshaft Fuel Pump	55	6629	Gasket — Oil Pump Inlet Tube
23	6303	Crankshaft Assy.	56	6670	Ring — Oil Pump Intermediate Shaft
24	6306	Sprocket — Crankshaft	57	6674	Spring — Oil Pump Relief Valve
25	6359	Spacer — Damper	58	6700	Plunger — Oil Pump Relief Valve
26	6A312	Pulley Assy. — Crankshaft Outer	59	6701	Seal — Cylinder Front Cover Oil
27	6316	Damper Assy. — Crankshaft	60	7007	Packing — Crankshaft Rear
28	6333	Bearing — Crankshaft Main (except center)	61	377850-S	Plate — Engine Rear
29	6337	Bearing — Crankshaft Main (center)	62	42998-S	Bolt — 5/8-18 x 2"
30	6345	Bolt — Crankshaft Main Bearing Cap	63	43002-S	Bolt — 3/8-16 x 1"
31	*	Main Bearing Cap — Supplied in 6010 Block Assy.	64	42911-S	Bolt — 3/8-16 x 1-1/2"
32	6375	Flywheel Assy.	65	42911-S	Bolt — 1/4-20 x 5/8"
33	6378	Washer — Crankshaft Pulley Retaining	66	378189-S	Pin — Dowel — 5/16 x 1-3/8"
			67	372854-S	Key — Woodruff — 1-3/4 x 7/32 x 3/16"
				357235-S	Bolt — 5/16-18 x 7/8"

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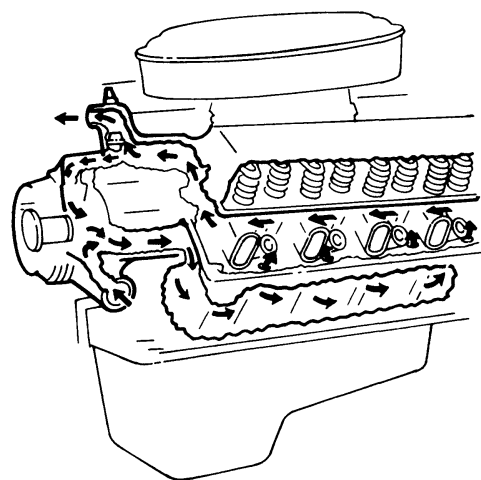
FIG. 2 Internal Exploded View—Key



A5506-1A

FIG. 3 Typical Lubrication System**EXHAUST EMISSION CONTROL SYSTEM**

The exhaust emission control devices used on these engines are covered in Group 29 of this Manual.



A5506-1A

FIG. 4 Typical Cooling System**CRANKCASE VENTILATION SYSTEM**

These engines are equipped with a positive closed-type crankcase ventilation system directing the crankcase vapors to the intake manifold for combustion.

DIAGNOSIS AND TESTING

Refer to Diagnosis and Testing in Part 21-01, General Gasoline Engine Service.

ADJUSTMENTS**VALVE CLEARANCE**

The valve arrangement of the left bank is E-I-E-I-E-I-E-I and on the right bank is I-E-I-E-I-E-I-E.

A 0.060 inch shorter push rod or a 0.060 inch longer push rod are available for service to provide a means of compensating for dimensional changes in the valve mechanism. Refer to the Master Parts List or the Specifications listed at the end of this Part for the pertinent color code.

Valve stem to valve rocker arm clearance should be within specifications with the hydraulic tappet completely collapsed. Repeated valve reconditioning operations (valve and/or valve seat refacing) will decrease the clearance to the point that if it is not compensated for, the hydraulic valve tappet will cease to function and the valve will be held closed.

The positive stop rocker arm bolt eliminates the necessity of adjusting the valve clearance. However, to obtain the specified valve clearance, it is important that all valve components be in a serviceable condition and installed and torqued properly.

To determine whether a shorter or a longer push rod is necessary, make the following check.

5.0L (302 CID) V-8 ENGINE

1. Install an auxiliary starter switch. Crank the engine with the ignition switch OFF until the No. 1 piston is on TDC after the compression stroke.
2. With the crankshaft in the positions designated in Steps 3, 4 and 5, position the tappet compressor tool on the rocker arm.

Slowly apply pressure to bleed down the tappet until the plunger is completely bottomed (Fig. 5). Hold the tappet in this position and check the available clearance between the rocker arm and the valve stem tip with a feeler gauge.

If the clearance is less than specifications, install a shorter push rod.

If the clearance is greater than specifications, install a longer push rod.



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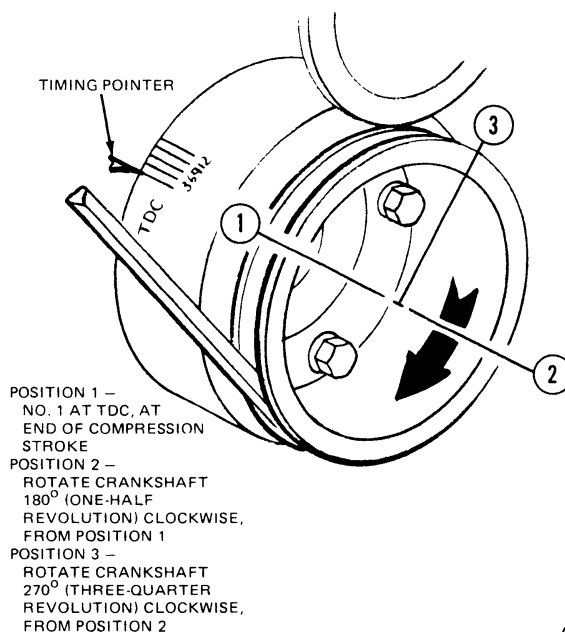
FIG. 5 Checking Valve Clearance—Hydraulic Valve Lifters

3. With the No. 1 piston on TDC at the end of the compression stroke, POSITION 1 in Fig. 6, check the following valves:
 - No. 1 Intake No. 1 Exhaust
 - No. 7 Intake No. 5 Exhaust
 - No. 8 Intake No. 4 Exhaust
4. Rotate the crankshaft to POSITION 2 in Fig. 6 and check the following valves.
 - No. 5 Intake No. 2 Exhaust
 - No. 4 Intake No. 6 Exhaust
5. Rotate the crankshaft to POSITION 3 in Fig. 6 and check the following valves.
 - No. 2 Intake No. 7 Exhaust
 - No. 3 Intake No. 3 Exhaust
 - No. 6 Intake No. 8 Exhaust

5.8L (351 CID) W-V-8 ENGINE

1. Disconnect the brown lead (I terminal) and the red and blue lead (S terminal) at the starter relay.
Install an auxiliary starter switch between the battery and S terminals of the starter relay. Crank the engine with the ignition switch OFF until the No. 1 piston is on TDC on the compression stroke.
2. With the crankshaft in the positions designated in Steps 3, 4 and 5, position the tappet compressor tool on the rocker arm. Slowly apply pressure to bleed down the tappet until the plunger is completely bottomed (Fig. 5). Hold the tappet in

WITH NO. 1 AT TDC, AT END OF COMPRESSION STROKE, MAKE A CHALK MARK AT POINTS 2 AND 3 APPROXIMATELY 90 DEGREES APART.



A3234-1E

FIG. 6 Position of Crankshaft for Checking and Adjusting Valve Clearance

this position and check the available clearance between the rocker arm and the valve stem tip with a feeler gauge.

3. With the No. 1 piston on TDC at the end of the compression stroke, POSITION 1 in Fig. 6 check the following valves:
 - No. 1 Intake No. 1 Exhaust
 - No. 4 Intake No. 3 Exhaust
 - No. 8 Intake No. 7 Exhaust
4. After these valves have been checked, rotate the crankshaft to POSITION 2 in Fig. 6 and check the following valves:
 - No. 3 Intake No. 2 Exhaust
 - No. 7 Intake No. 6 Exhaust
5. After these valves have been checked, rotate the crankshaft to POSITION 3 in Fig. 6 and check the following valves:
 - No. 2 Intake No. 4 Exhaust
 - No. 5 Intake No. 5 Exhaust
 - No. 6 Intake No. 8 Exhaust

If the clearance is less than specifications, install a shorter push rod. If the clearance is greater than specifications, install a longer push rod.

REMOVAL AND INSTALLATION

When installing nuts or bolts that must be tightened (refer to torque specifications), oil the threads with light

weight engine oil. **Do not oil threads that require oil-resistant or water-resistant sealer.**

Refer to Part 21-01 for Cleaning, Inspection and Test procedures.

ENGINE ASSEMBLY

The engine removal and installation procedures are for the engine only without the transmission attached.

F-100—F-150, F-250—Bronco

Removal

1. Drain the cooling system (refer to Part 27-02, General Cooling System Service) and the crankcase. Remove hood (Part 44-21).
2. Disconnect the battery and alternator ground cables from the cylinder block.
3. Remove the air cleaner and intake duct assembly, including the crankcase ventilation hose and carbon canister hose.
4. Disconnect the radiator lower and upper hose at the radiator. If equipped with an automatic transmission, disconnect the transmission oil cooler lines.
5. If so equipped, discharge the A/C system and remove the A/C condenser (refer to Group 36). Disconnect A/C lines at the compressor.
6. Remove the fan shroud and position it over the fan. Remove the radiator (refer to Part 27-04). Remove the fan shroud, fan spacer, belts and pulley.
7. Remove the alternator bolts and allow the alternator to swing down and out of the way.
8. Disconnect the oil pressure sending unit wire from the sending unit, and the flexible fuel line at the fuel tank line. Plug the fuel tank line. Disconnect evaporative emission hoses at the evaporative canister.
9. Disconnect the accelerator cable from the carburetor. Disconnect speed control linkages if so equipped. Disconnect the transmission kickdown rod and remove the retracting spring if so equipped. Disconnect power brake booster vacuum hose, if so equipped.
10. Disconnect the heater hoses from the water pump and intake manifold. Disconnect the water temperature sending unit wire from the sending unit.
11. Remove the flywheel housing-to-engine upper bolts.
12. Disconnect the primary wire from the ignition coil. Remove the wire harness from the left rocker arm cover and position the wires out of the way. Disconnect the ground strap from the cylinder block.
13. Raise the front of the vehicle. Disconnect the starter cable from the starter. Remove the starter (refer to Group 28).
14. Disconnect the muffler inlet pipes from the exhaust manifolds. Disconnect the engine support insulators from the brackets on the frame underbody.

On a vehicle with automatic transmission, remove the converter inspection plate. Remove the torque converter-to-flywheel attaching bolts.

Remove the remaining flywheel housing-to-engine bolts.

15. If so equipped, disconnect A/C compressor magnetic clutch load wire (refer to Group 36).
16. Lower the vehicle, and then support the transmission. Install the engine lifting brackets on the front of the left cylinder head, and install the engine right lifting bracket at the rear of the right cylinder head. Then attach the engine lifting sling (Fig. 7).

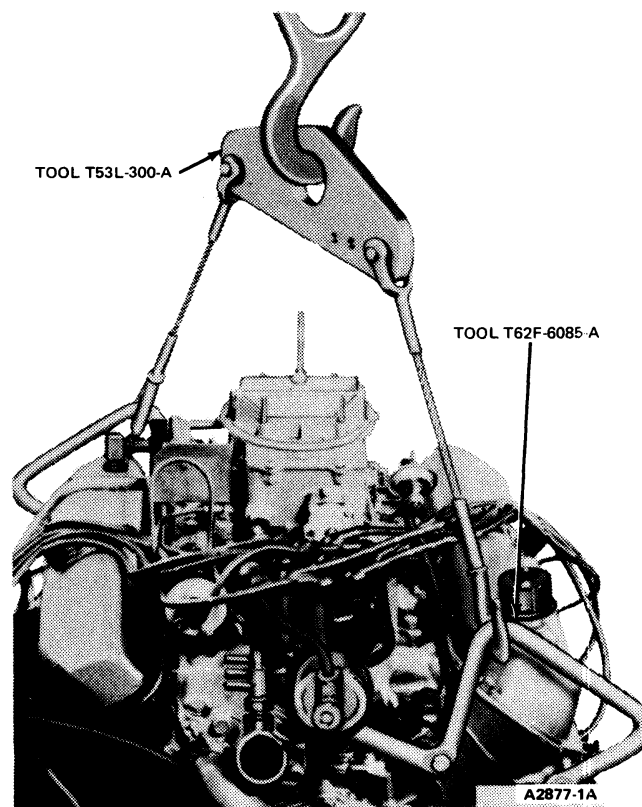


FIG. 7 Typical Engine Lifting Brackets and Sling

17. Raise the engine slightly and carefully pull it from the transmission. Carefully lift the engine out of the engine compartment so that the rear cover plate is not bent or other components damaged. Install the engine on a workstand.

Installation

1. Attach the engine lifting brackets and sling (Fig. 7). Remove the engine from the workstand.
2. Lower the engine carefully into the engine compartment. Make sure the dowels in the block are through the rear cover plate, then engage the holes in the flywheel housing.

On a vehicle with manual transmission, start the transmission main drive shaft into the clutch disc. It may be necessary to adjust the position of the transmission in relation to the engine if the input shaft will not enter the clutch disc. **If the engine hangs up after the shaft enters, turn the crankshaft slowly (transmission in gear) until the shaft splines mesh with the clutch disc splines.**

3. Install the flywheel housing upper bolts.

4. Install the engine support insulator-to-bracket washers and attaching nuts. Disconnect the engine lifting sling and remove the lifting eyes.
5. Raise the front of the vehicle. Connect both exhaust manifolds to the muffler inlet pipes. Tighten the nuts to specifications (refer to Part 26-01, General Exhaust Systems Service).
6. Position and install the starter and the starter cable (refer to Group 28).
7. Install the remaining flywheel housing-to-engine bolts.
8. On a vehicle with automatic transmission, install the converter-to-flywheel attaching bolts. Install the converter inspection plate.
9. Remove the support from the transmission and lower the vehicle.
10. If so equipped, connect the A/C compressor magnetic clutch lead (refer to Group 36).
11. Connect the wiring harness to the left valve rocker arm cover and connect the coil wire.
12. Connect the water temperature sending unit wire.
13. Connect the bellcrank to the intake manifold. Connect the transmission shift rod and install the retracting spring. Connect the accelerator rod and speed control linkage, if so equipped.
14. Remove the plug from the fuel tank line and connect the fuel line and the oil pressure sending unit wire. Reconnect evaporative emission hoses at the evaporative canister.
15. Install the pulley, belt, spacer and fan. Position the fan shroud over the fan.
16. Position the alternator and install the alternator bolts. Connect the alternator and the battery ground cables. Adjust the belt tension to specifications listed at the end of this Part.
17. If so equipped, connect two A/C lines to the A/C compressor (refer to Group 36).
18. Install the radiator (refer to Part 27-04). Connect the radiator upper and lower hoses. Connect the transmission oil cooler lines if so equipped. Install the fan shroud.
19. If so equipped, install the A/C condenser to the radiator (refer to Group 36).
20. Connect the heater hose at the water pump. Fill and bleed the cooling system (refer to Part 27-02, General Cooling System Service). Fill the crankcase with the proper grade and quantity of oil. Connect the power brake booster vacuum hose, if so equipped.
21. Operate the engine at fast idle and check all gaskets and hose connections for leaks.
22. Install the air cleaner and intake duct assembly including the crankcase ventilation hose and carbon canister hose.
23. Adjust idle speed and mixture to specifications on Engine decal.
24. Evacuate and charge the A/C System (if so equipped) following instructions in Group 36.
25. Install hood (Part 44-21).

E-100—E-250**Removal**

1. Remove engine cover, open the hood, disconnect battery, drain cooling system (refer to Part 27-02, General Cooling System Service), and remove grille assembly including gravel deflector.
2. Remove the upper grille support bracket, hood lock support and condenser upper mounting brackets.
3. If so equipped, discharge the A/C system, and remove the A/C condenser (refer to Group 36). Disconnect the A/C lines at the compressor, and remove the accelerator cable bracket. Disconnect the speed control linkage if so equipped. Disconnect the two heater hoses from the engine.
4. Disconnect the upper radiator hose.
5. Disconnect the radiator lower hoses at the radiator. If equipped with an automatic transmission, disconnect the oil cooler lines at the radiator.
6. Remove the fan shroud and fan assembly. Remove the radiator from the vehicle (refer to Group 27). Pivot the alternator inward. Disconnect the alternator lead wires at the alternator.
7. Remove the air cleaner assembly, also remove the duct and valve assembly and exhaust manifold shroud. Remove the flex tube from the exhaust manifold stove.
8. Disconnect the throttle at the carburetor and remove the accelerator cable bracket from the engine. Disconnect the transmission shift rod if so equipped.
9. Disconnect the fuel line, choke lines, and then remove the carburetor and carburetor spacer. (Includes disconnecting vacuum lines). Disconnect evaporative emission hoses, where applicable, from front of carburetor pad and/or top of PCV valve. Disconnect hose at carburetor bowl vent and vacuum hose from evaporative canister to vacuum harness at the harness. Raise the vehicle on the hoist, drain the crankcase and remove the oil filter. Disconnect the power brake booster vacuum hose, if so equipped.
10. Disconnect the muffler inlet pipe at the exhaust manifolds. Remove two bolts retaining the transmission filler tube bracket to the right cylinder head.
11. Remove the engine mount attaching bolts and nuts (Fig. 8). Remove the starter motor and disconnect the cable. On vehicles equipped with a manual transmission, remove the housing to engine bolts. On vehicles equipped with an automatic transmission, remove the converter inspection cover bolts.
12. Remove four nuts attaching the converter to the flex plate.
13. Remove three bolts retaining the adapter plate to the converter housing.
14. Remove four converter housing-to-cylinder block lower bolts. Remove the bolt retaining the ground cable to the cylinder block. Lower the vehicle and support the transmission.

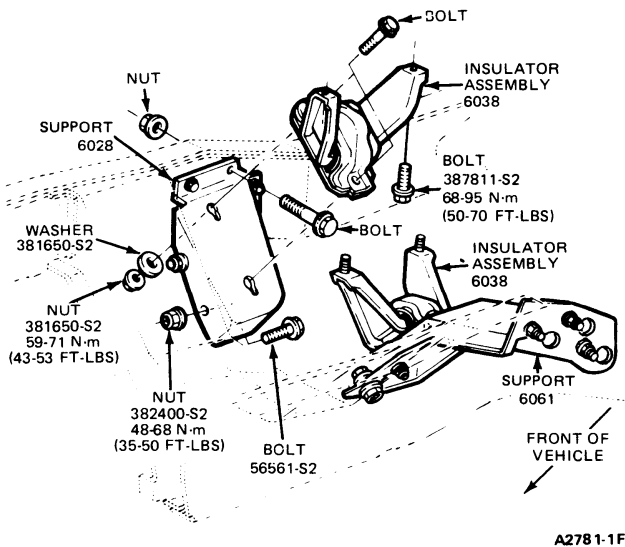


FIG. 8 Engine Front Supports—E-100—E-250 with 5.0L (302 CID) V-8 and 5.8L (351 CID) W-V-8

15. If so equipped loosen the power steering pump bracket and remove the drive belt. Remove the power steering front bracket bolts.
16. Disconnect the engine wire loom and position it out of the way.
17. Remove the speed control servo and the accelerator cable bracket from the intake manifold, and position them out of the way (3 retaining bolts).
18. If so equipped, disconnect the A/C compressor magnetic clutch load wire (refer to Group 36). Install the lifting bracket (Fig. 7) to the intake manifold (attaching bolts). Remove two converter housing-to-cylinder block upper bolts.
19. Position a floor jack under the transmission for support. Position a floor crane to the vehicle and connect it to the lifting bracket which is attached to the intake manifold and carefully move engine forward in the engine compartment so that no components are damaged. Install the engine on a work stand (Fig. 7).
20. Remove the engine from the vehicle.

Installation

1. On vehicles equipped with an automatic transmission, connect the floor crane to the engine. Raise the engine and position it into the vehicle aligning the transmission converter to the flywheel (or flex plate) and the engine dowels to the transmission. Lower the engine to the chassis brackets, and align the through-bolt holes (Fig. 8).

On vehicles equipped with a manual transmission, start the transmission main clutch drive shaft into the clutch disc.

It may be necessary to adjust the position of the transmission in relation to the engine if the input shaft will not enter the clutch disc. If the engine hangs up after the shaft enters, turn the crankshaft slowly (transmission in gear) until the shaft splines mesh with the clutch disc splines.

Align the housing on the engine and insert the housing to engine bolts. Tighten bolts to specifications.

2. On vehicles equipped with an automatic transmission, install two converter housing-to-cylinder block lower bolts. Remove the lifting bracket from the intake manifold.
3. Remove floor jack from under the transmission, and position it out of the way.
4. If so equipped, connect the A/C compressor magnetic clutch lead. (refer to Group 36).
5. Connect the flex tube to the exhaust manifold stove. Position the accelerator cable mounting bracket and the speed control servo to the intake manifold, and install three attaching bolts.
6. Position the engine wire harness in retainers and connect at respective locations. Connect vacuum lines at the rear of the intake manifold. Connect the power brake booster vacuum hose, if so equipped.
7. Connect two heater hoses, one at the heater core and one at the water valve. If so equipped position the power steering front face bracket and the power steering pump to the water pump and the left cylinder head. Install the six attaching bolts.
8. Install the fan assembly and spacer to the water pump shaft and position the shroud over the fan assembly.
9. Raise the vehicle on a hoist. Install one bolt attaching ground cable to cylinder block. Install four lower converter housing-to-cylinder block lower bolts. Install the three adapter plate-to-converter housing bolts. Install four nuts retaining the converter to the flex plate. Install the converter inspection cover (bolts).
10. Install the starter motor and connect the cable. Install the engine mount attaching bolts and nuts. Tighten to specifications.
11. Install the two bolts that retain the transmission filler tube bracket to the right cylinder head.
12. Connect the muffler inlet pipe at the exhaust manifolds (refer to torque specifications in Part 26-01). Install the oil filter.
13. Lower the vehicle on hoist. Position the carburetor, with gasket, to the intake manifold, install four nuts, connect the fuel line, choke line, vacuum lines and the choke lead wires. Reconnect evaporative canister hoses to carburetor bowl vent, vacuum harness and intake manifold or PCV valve.
14. Connect the throttle and transmission linkage and the speed control linkage, if so equipped, at the carburetor. Connect the alternator lead wires to the alternator.
15. Position the power steering pump drive belt to its respective pulleys, adjust belt tension and tighten the retaining bolts (refer to Specifications at end of this Part). If so equipped, connect two A/C lines at the A/C compressor (refer to Group 36) and install the accelerator cable bracket to the dash.
16. Position the radiator to the radiator support and secure with four attaching bolts (refer to Group 27). Install the shroud and secure with four attaching bolts.

17. Connect two oil cooler lines at the radiator, if so equipped.
18. Connect the radiator lower hose at the radiator. Connect the radiator upper hose at the radiator.
19. Install the A/C condenser to radiator support, if so equipped (refer to Group 36). Install the grille upper support bracket, hood lock support and condenser upper mounting brackets.
20. Install the grille assembly. Fill the crankcase. Fill the cooling system (refer to Part 27-02, General Cooling System Service).
21. Connect battery, start engine and check for leaks. Adjust idle speed and mixture (refer to 1980 Truck Performance Specification Manual).
22. Evacuate and charge the A/C system, if so equipped (refer to Group 36). Install the air cleaner assembly.
23. Install the engine cover.

ENGINE FRONT SUPPORTS

The front supports are located on each side of the cylinder block. The procedures given apply to either a right or left installation. However, a sheet metal shield on the left side only is used on F-Series trucks.

F-100 and F-150

Removal

1. Remove the bolts attaching the fan shroud to the radiator and position the shroud over the fan.
2. Remove the nut and washer attaching the support insulator to the chassis bracket.
3. Raise the engine.
4. Remove the bolts and lock washers attaching the support insulator to the cylinder block (Fig. 9) and remove the insulator and heat shield; left side only.

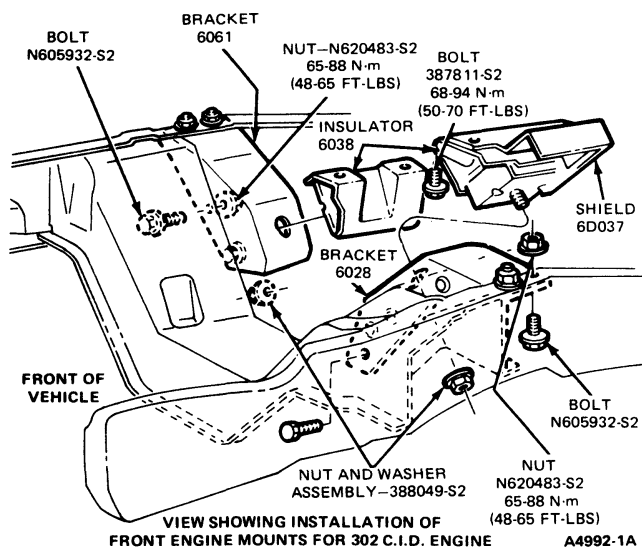


FIG. 9 Engine Front Supports—F-100, F-250—Bronco

Installation

1. Position the support insulator and heat shield, left side only to the cylinder block and install the attaching bolts and lockwashers loosely.

2. Carefully lower the engine, guiding the support insulator stud into the support bracket (Fig. 9). Tighten the insulator-to-engine bolts to specifications.
3. Install the insulator-to-chassis bracket nut and washer. Tighten the nut to specifications.
4. Install the fan shroud attaching bolts.

E-100—E-250

Removal

1. Remove fan shroud bolts. Remove the insulator to support nuts.
2. Position transmission jack under engine assembly. Lift engine assembly and then remove starter.
3. Remove insulator to engine bolts and alternator splash shield. Remove the insulators (Fig. 8).

Installation

1. Clear slots in engine block of debris, using a 7/16-14 bottoming tap.
2. Install insulators to engine using **new** bolts and tighten to specifications (Fig. 8).
3. Replace starter and then lower the engine assembly. Move transmission jack out of the way.
4. Replace the insulator to support nuts and tighten. Install fan shroud and bolts.

ENGINE REAR SUPPORTS

The procedures given apply to F-100, F-250 and Bronco and E-100—E-250 center mount (Figs. 10 and 11).

F-100 AND F-250, AND BRONCO

Removal

1. Remove the support insulator-to-crossmember attaching bolt and locknut (Fig. 10).
2. Remove the support insulator-to-transmission extension housing bolts and lockwashers.
3. Raise the transmission with a floor jack. Remove the support insulator and retainer.

Installation

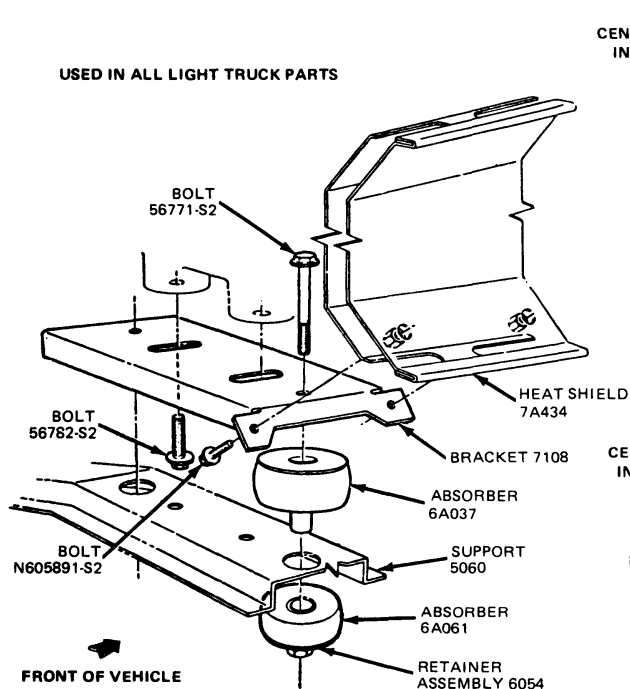
1. Position the support insulator and retainer on the transmission extension housing (Fig. 10).
2. Install the support insulator-to-transmission extension housing bolts and lockwashers. Tighten the bolts to specifications. Lower the transmission.
3. Install the support insulator-to-crossmember attaching bolt and lock nut. Tighten the nut to specifications.

Check to see that the retainer does not contact the portion of the insulator which is attached to the crossmember.

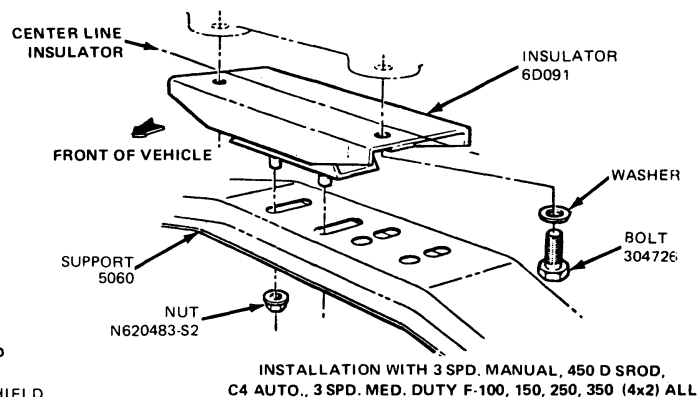
E-100—E-250

Removal

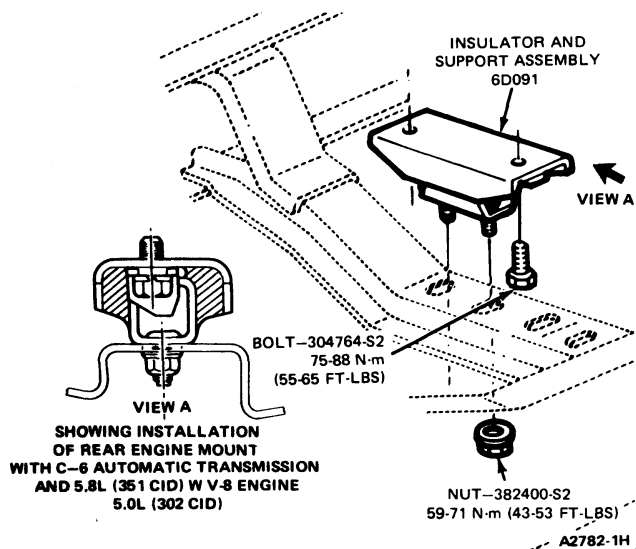
1. Raise the vehicle on a hoist.
2. Remove the insulator support nuts securing the rear insulator support to the frame crossmember (Fig. 11).
3. Raise the transmission with a jack so that the insulator support clears the frame.



INSTALLATION U-150, F-150, 250, 350 (4x4) (B)

INSTALLATION WITH C6, NP435, 4 SPD. TRANS.
F-100, 150, 250, 350 (4x2) ALL

A4991-2A

FIG. 10 Engine Rear Support—F-100—F-150**FIG. 11 Engine Rear Support E-100—E-250**

4. Remove the insulator support bolts securing the rear insulator support to the transmission, then remove the insulator.

Installation

1. Position the insulator support, then install the bolts securing the insulator support to the transmission (Fig. 11). Tighten the bolts to specifications.
2. Lower the jack supporting the transmission and align the insulator support bolt holes with the holes in the frame assembly.

3. Install the bolts and nuts securing the insulator support to the frame. Tighten to specification.
4. Lower the vehicle.

CRANKCASE VENTILATION SYSTEM

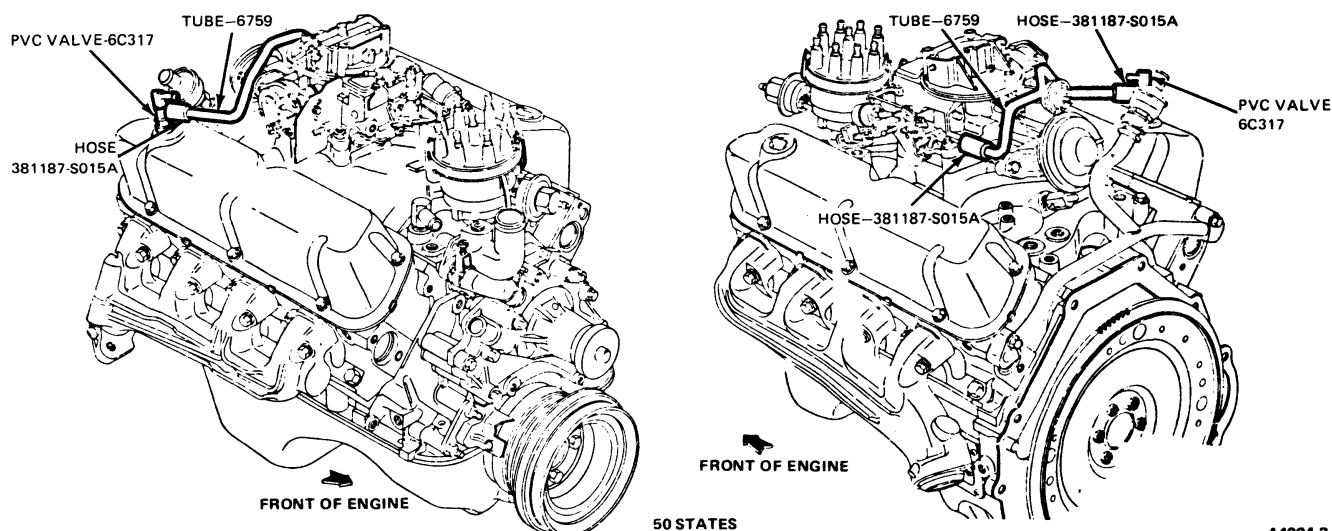
The crankcase ventilation system components for the various applications are shown in Figs. 12 and 13. **Any modification of the system prior to the first sale and registration of the vehicle is subject to Federal (U.S.A.) law and to the penalties under the laws of some states thereafter.**

F-100, F-250, BRONCO**Removal**

1. Disconnect the crankcase vent rear hose from the air cleaner. Pull the hose and elbow out of the grommet in the valve rocker arm cover. Remove the elbow from the vent hose.
2. Remove the air cleaner and intake duct assembly.
3. Disconnect the crankcase vent front tube from the carburetor spacer and the PCV valve in the rocker arm cover.
4. Remove the cam-lock oil filler cap from the valve rocker arm cover. Pull the PCV valve out of the grommet in the rocker arm cover.

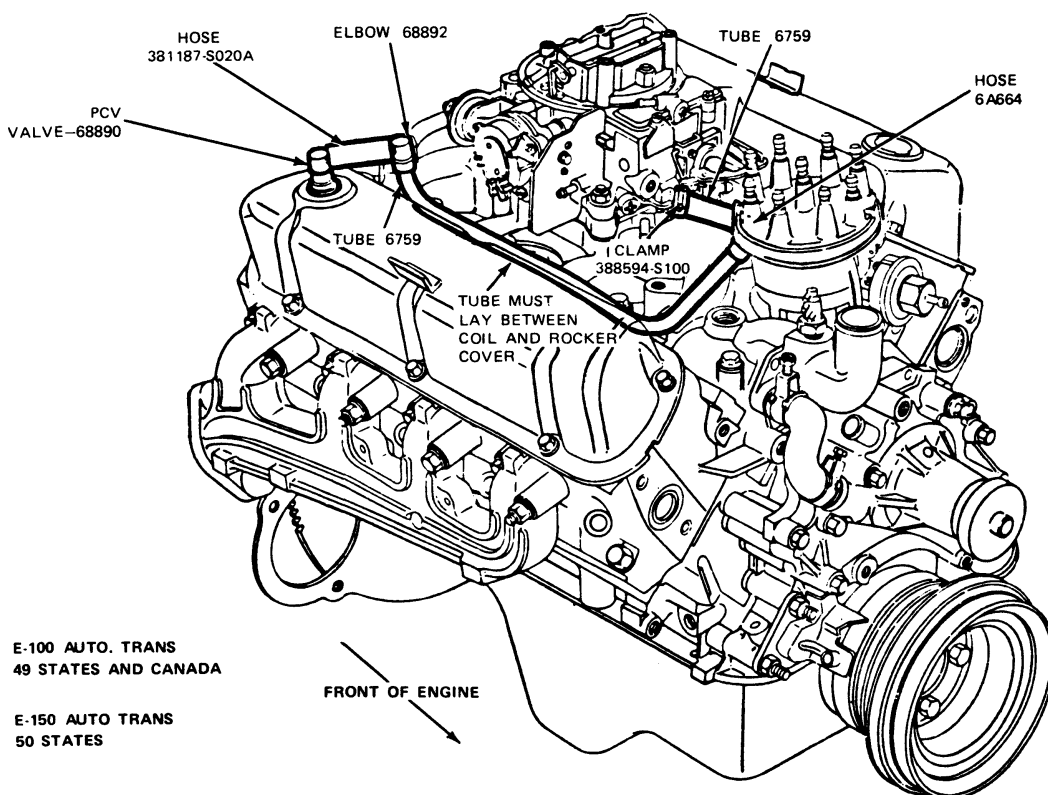
Installation

1. Insert the PCV valve into the grommet in the oil filler cap. Install the oil filler cap in the valve rocker arm cover and turn the cap to lock it into position.
2. Connect the crankcase vent front tube to the PCV valve and the carburetor spacer.
3. Install the air cleaner and intake duct assembly.



A4994-2A

FIG. 12 Typical Crankcase Ventilation System—5.0L (302 CID) V-8



A4993-2A

FIG. 13 Typical Crankcase Ventilation System—5.8L (351 CID) W-V-8

4. Insert the elbow into the grommet in the valve rocker arm cover. Connect the crankcase vent rear hose to the elbow and the air cleaner.
5. Start the engine and check for leaks.

E-100—E-250

Removal

1. Disconnect the crankcase vent front hose from the air cleaner.
2. Remove the air cleaner and intake duct assembly. If so equipped, disconnect the oil filter pipe hose from the left rocker arm cover.

3. Disconnect the crankcase vent rear hose from the carburetor spacer, at the rear of the carburetor or intake manifold. Pull the hose and PCV valve out of the grommet in the valve rocker arm cover. Remove the PCV valve from the vent hose.

Installation

1. Insert the PCV valve into the grommet in the valve rocker arm cover. Connect the crankcase vent rear hose to the PCV valve and the carburetor spacer or intake manifold, or rear of carburetor.
2. Install the air cleaner and intake duct assembly. If so equipped, connect the oil filter pipe hose to the left rocker arm cover.

3. Connect the crankcase vent front hose to the air cleaner and the oil filler tube.
4. Start the engine and check for leaks.

VALVE ROCKER ARM COVER AND ROCKER ARM

F-100—F-250 AND BRONCO

Removal

1. Remove air cleaner and intake duct assembly, including the closed crankcase ventilation hoses. On 5.0L (302 CID) V-8 Canadian F-150, 250, Bronco remove vacuum lines and electric solenoid. Remove vacuum solenoid LH cover only.
2. Remove the PCV valve from the right rocker arm cover.
3. Disconnect the spark plug wires from the spark plugs by grasping, twisting and pulling the moulded cap using Tool No. T68P-6666-A or equivalent. Remove the wires and bracket assemblies from the rocker arm cover attaching studs and position out of the way.
4. Remove low voltage wiring clips. Remove rocker arm cover(s).
5. Remove the valve rocker arm fulcrum bolt, fulcrum, rocker arm and fulcrum guide.

Installation

The valve rocker arm assembly is shown in Fig. 14.

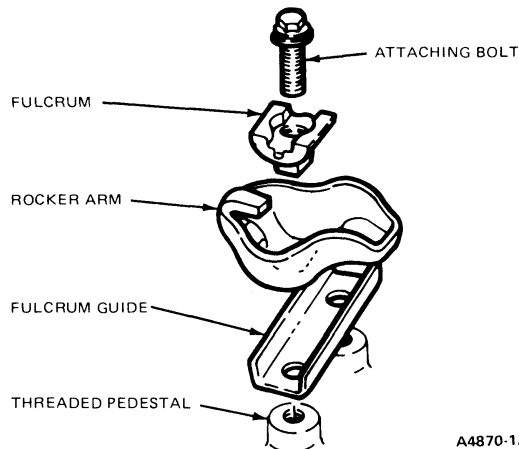


FIG. 14 Valve Rocker Arm Assembly

1. Apply Lubriplate or equivalent to the top of the valve stem, the fulcrum and socket.
2. Install the fulcrum guide, valve rocker arm, fulcrum and fulcrum bolt. Tighten to specifications.
3. Clean and inspect gasket surfaces. Inspect the gasket sealing surface for damages and distortion due to overtightening of the bolt. Repair and straighten as required.
4. Place the new gaskets in the covers making sure that the tabs of the gasket engage the notches provided in the cover. Position the cover(s) on the cylinder head(s). Install the bolts and tighten to specifications. Two minutes later tighten the bolts to the same specifications.

5. Install low voltage wiring clips. Insert the spark plug wires and bracket assembly on the attaching stud on the rocker arm cover(s) and connect the wires to the spark plugs.
6. Install the PCV valve into the oil filler cap in the rocker arm cover. Install vacuum solenoid connect vacuum harness and electric connectors.
7. Install air cleaner and intake duct assembly, including the crankcase ventilation hoses.

E-100—E-350

Removal

1. Remove air cleaner and intake duct assembly, including the crankcase ventilation hoses.
2. Disconnect oil filler pipe hose from left rocker arm cover.
3. Remove the PCV valve from the right rocker arm cover if so equipped.
4. Disconnect the spark plug wires from the spark plugs by grasping, twisting and pulling the moulded cap by using Tool No. T74P-6666-A or equivalent. Remove wires and bracket assembly from the rocker arm cover attaching stud and position out of the way.
5. Remove vacuum harness to amplifier on R.H. cover and vacuum harness and electrical connector to vacuum solenoid on L.H. rocker cover, if so equipped.
6. Disconnect evaporative canister hoses from the tube harness on the chassis and position out of the way.
7. Disconnect the thermactor air supply hose at the air pump and move aside.
8. Remove rocker arm cover(s).
9. Remove the valve rocker arm bolt, fulcrum seat and rocker arm.

Installation

1. Apply Lubriplate or equivalent to the top of the valve stem, the fulcrum seat and socket.
2. Install the fulcrum guide, valve rocker arm, fulcrum seat and bolt. Tighten to specifications.
3. Clean and inspect gasket surfaces. Inspect the gasket sealing surface for damages and distortion due to overtightening of the bolt. Repair and straighten as required. Place the new gaskets in the covers, making sure that the tabs of the gasket engage the notches provided in the cover.
4. Position the cover(s) on the cylinder head(s). Install the bolts and tighten to specifications. Two minutes later, tighten the bolts to the same specifications.
5. Reconnect vacuum harness to amplifier on RH cover and vacuum harness and electrical connector to vacuum solenoid on LH rocker cover, if so equipped, the rocker arm cover.
6. Connect spark plug wires and bracket assembly to attaching stud on rocker arm cover and connect wires at spark plugs.
7. Install the PCV valve into the right rocker arm cover.
8. Reconnect evaporative canister hoses to the chassis tube harness.
9. Reconnect thermactor air supply hose at air pump (351W only).

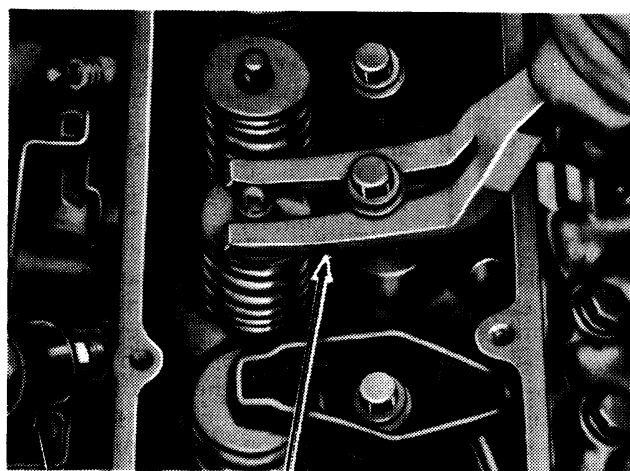
10. Connect the oil filler pipe hose to the left rocker arm cover.
11. Install the air cleaner and intake duct assembly, including the crankcase ventilation hoses.

VALVE SPRING, RETAINER AND STEM SEAL

Removal

Broken valve springs or damaged valve stem seals and retainers may be replaced without removing the cylinder head, provided damage to the valve or valve seat has not occurred.

1. Refer to Valve Rocker Arm Cover in this section for the cover removal and installation.
2. Remove the applicable spark plug and bring the piston to the top of the bore to prevent accidental loss of the valve into the cylinder.
3. Remove the valve rocker arm fulcrum bolts, fulcrum seats, valve rocker arms and push rods from the applicable cylinder. Remove the exhaust valve stem cap.
4. Install an air line with an adapter in the spark plug hole and apply air pressure to the cylinder. Failure of the air pressure to hold the valve(s) in the closed position is an indication of valve seat damage and requires removal of the cylinder head.
5. Install the fulcrum bolt and position the compressor tool as shown in Fig. 15. Compress the valve spring and remove the retainer locks, spring retainer, sleeve and valve spring.
6. Remove and discard the valve stem seal (Fig. 16).



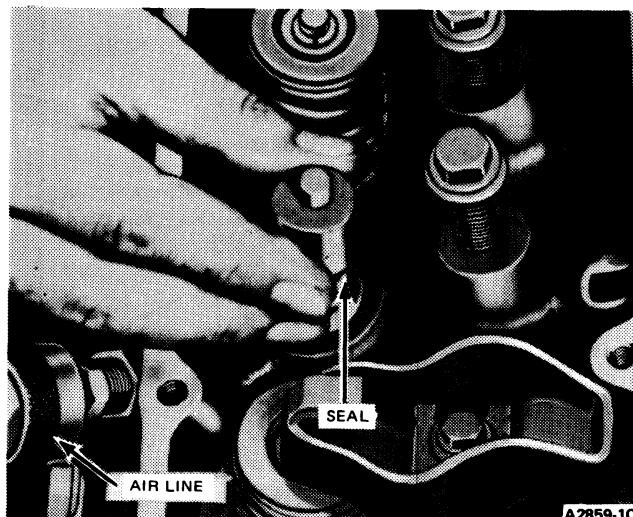
AIR LINE

TOOL—T62F-6565-A
OR 6513-HH

A2858-1C

FIG. 15 Compressing Valve Spring—In Chassis

7. If air pressure has forced the piston to the bottom of the cylinder, any removal of air pressure will allow the valve(s) to fall into the cylinder. A rubber band, tape or string wrapped around the end of the valve stem will prevent this condition and will still allow enough travel to check the valve for binds.
8. Inspect the valve stem for damage. Rotate the valve and check the valve stem tip for eccentric movement during rotation. Move the valve up and



A2859-1C

FIG. 16 Removing or Installing Valve Stem Seal

down through normal travel in the valve guide and check the stem for binds. **If the valve has been damaged, it will be necessary to remove the cylinder head for repairs as outlined in Part 21-01.**

Installation

1. If the condition of the valve proved satisfactory, lubricate the valve stem with heavy engine oil SE. Hold the valve in the closed position and apply air pressure within the cylinder.
2. Install a new valve stem seal (Fig. 16) using a 5/8-inch deep wall socket and a light hammer or mallet to drive the seal onto the valve stem. Place the spring in position over the valve and install the valve spring retainer and sleeve. Compress the valve spring and install the valve spring retainer locks. Remove the compressor tool and fulcrum bolt.
3. Lubricate the push rod ends with Lubriplate or equivalent and install the push rod. Apply Lubriplate or equivalent to the tip of the valve stem. Install the exhaust valve stem cap.
4. Apply Lubriplate or equivalent to the rocker arms and fulcrum. Install the valve rocker arms, fulcrum and fulcrum bolts. Tighten to specifications.
5. Turn off the air and remove the air line and adapter. Install the spark plug and connect the spark plug wire.
6. Clean and install the rocker arm cover.

INTAKE MANIFOLD

The intake manifold assemblies are shown in Figs. 17 and 18.

Removal

1. Drain the cooling system. Remove the air cleaner and intake duct assembly, including the crankcase ventilation hose.
2. Disconnect the accelerator cable and speed control linkage (if so equipped) from the carburetor. Remove the accelerator cable bracket. Disconnect the automatic transmission kickdown rod at the

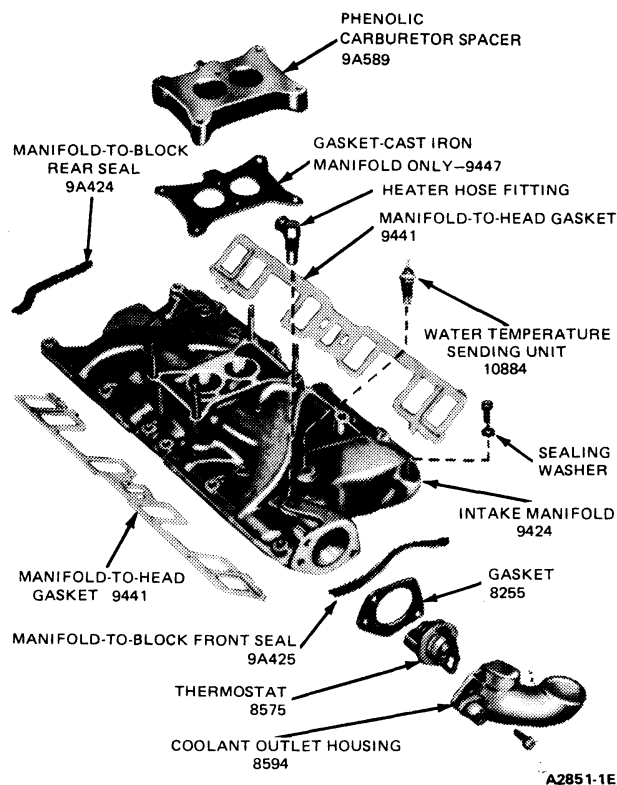


FIG. 17 Intake Manifold Assembly—5.0L (302 CID) V-8 and 5.8L (351 CID) W-V-8

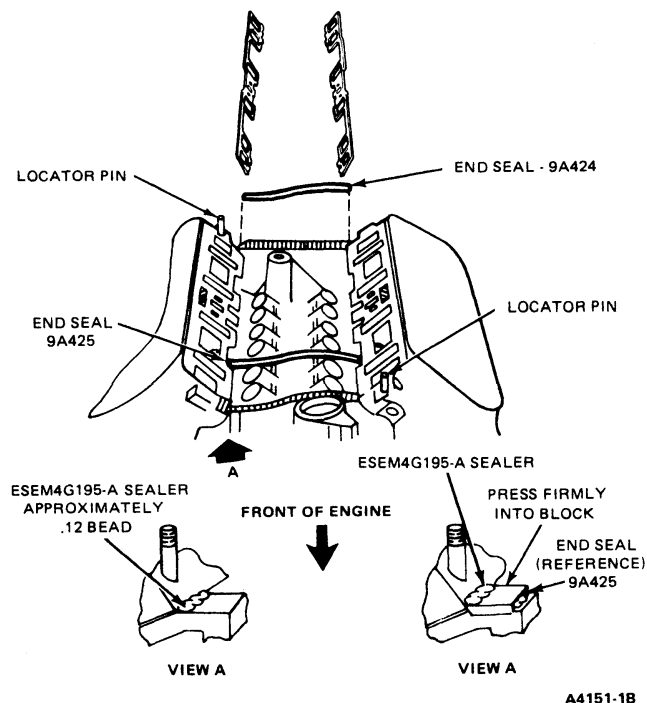


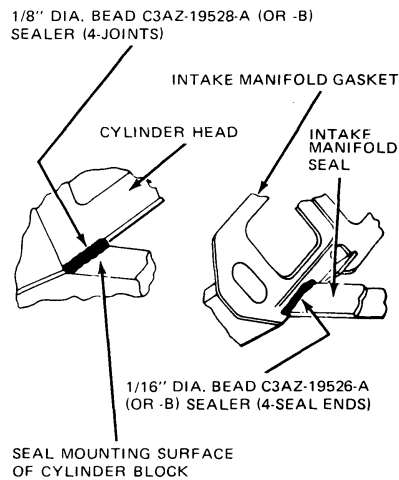
FIG. 18 Installation of Manifold Gaskets and End Seals—E-100—E-150 5.0L (302 CID) and 5.8L (351 CID) W-V-8 and E-350—50 States Only

carburetor (if so equipped). Disconnect the electric choke and carburetor solenoid wires, if so equipped.

3. Disconnect the high-tension lead and wires from the coil.
4. Disconnect the spark plug wires from the spark plugs by grasping, twisting and pulling the moulded cap using Tool No. T74P-6666-A or equivalent. Remove the wires and bracket assembly from the rocker arm cover attaching stud. Remove the distributor cap and spark plug wires as an assembly.
5. Remove the carburetor fuel inlet line.
6. Disconnect the distributor vacuum hoses from the distributor. Remove the distributor hold down bolt and remove the distributor. Disconnect evaporative hoses.
7. Disconnect the radiator upper hose from the coolant outlet housing, and the water temperature sending unit wire at the sending unit. Remove the heater hose from the intake manifold.
8. Loosen the clamp on the water pump by-pass hose at the coolant outlet housing and slide the hose off the outlet housing.
9. Disconnect the crankcase vent hose at the valve rocker arm cover.
10. Remove the intake manifold and carburetor as an assembly. **It may be necessary to pry the intake manifold away from the cylinder heads. Remove the intake manifold gaskets and seals. Discard the intake manifold attaching bolt sealing washers.**
11. If the manifold assembly is to be disassembled, identify all vacuum hoses before disconnecting them. Remove the coolant outlet housing gasket and thermostat. Remove the ignition coil, temperature sending unit, carburetor, spacer, gasket, vacuum fitting, accelerator retracting spring bracket and choke cable bracket.

Installation

1. If the intake manifold assembly was disassembled, install the temperature sending unit (threads coated with electrical conductive sealer), ignition coil, carburetor, spacer, gaskets, vacuum fitting, accelerator retracting spring bracket and choke cable bracket. Position the thermostat in the coolant outlet housing. Coat the thermostat gasket with water-resistant sealer and position it on the coolant outlet housing. Install the coolant outlet housing. Connect all vacuum hoses.
2. Clean the mating surfaces of the intake manifold, cylinder heads and cylinder block using a solvent such as Ford Spot Remover (B7A-19521-A) or equivalent. Apply a 1/8 inch bead of RTV sealer, (C3AZ-19562-B or equivalent) at the points shown in Fig. 19.
3. Apply a 1/16 inch bead of RTV sealer to the outer end of each intake manifold seal for the full width of the seal (4 places). See Fig. 19. **NOTE: This sealer sets-up in 15 minutes, so it is important that assembly be completed promptly. Do not drip any sealer into the engine valley. Position the seals on the cylinder block and new gaskets on**



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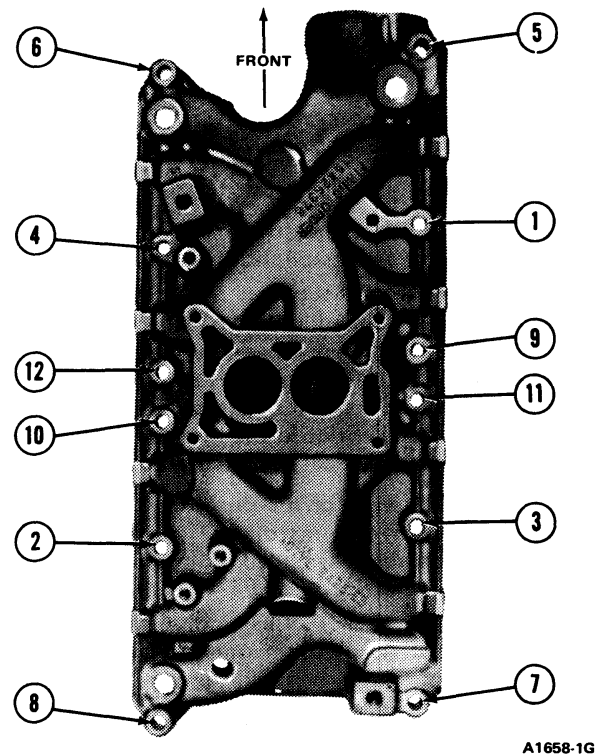
FIG. 19 RTV Sealer Installation—Intake Manifold

the cylinder heads with the gaskets interlocked with the seal tabs. Be sure the holes in the gaskets are aligned with the holes in the cylinder heads.

4. Carefully lower the intake manifold into position on the cylinder block and cylinder heads. **After the intake manifold is in place, run a finger around the seal area to make sure the seals are in place. If the seals are not in place, remove the intake manifold and position the seals.**
5. Be sure the holes in the manifold gaskets and manifold are in alignment. Install the intake manifold attaching nuts and bolts. Tighten the nuts and bolts in two steps (Fig. 20). Tighten all nuts and bolts in sequence to specifications.

After completing the remaining assembly steps, operate the engine until it reaches normal operating temperature, then re-tighten the manifold nuts and bolts in sequence to specifications.

6. Install the water pump by-pass hose on the coolant outlet housing. Slide the clamp into position and tighten the clamp.
7. Connect the radiator upper hose. Install the heater hose and connect the hose to the intake manifold.
8. Install the carburetor fuel inlet line.
9. Rotate the crankshaft damper until the No. 1 piston is on TDC at the end of the compression stroke. On engines equipped with the breakerless ignition system, install the distributor following the procedure in Part 23-01 for breakerless ignition systems.
10. Install the distributor cap. Connect the spark plug wires and bracket assembly to attaching stud on rocker arm cover and connect the wires to the plugs.
11. Connect crankcase vent hose. Connect the high-tension lead and coil wires.
12. Connect accelerator cable and accelerator cable bracket. Connect speed control cable, if so equipped. Connect the choke cable. Connect electric choke and carburetor wires, if so equipped. Connect the automatic transmission kickdown rod



A1658-1G

FIG. 20 Intake Manifold Bolts Tightening Sequence

at the carburetor (if so equipped). Reconnect evaporative canister hoses.

13. Fill and bleed the cooling system.
14. Start the engine and check and adjust the ignition timing. Connect the distributor vacuum hoses to the distributor.
15. Operate the engine at fast idle and check all hose connections and gaskets for leaks. Operate the engine until engine temperatures have stabilized and adjust the engine idle speed and idle fuel mixture to specifications on engine decal. Re-tighten the intake manifold bolts to specifications.
16. Adjust the transmission throttle linkage. Install the air cleaner and intake duct assembly, including the closed crankcase ventilation hose.

TAPPET

Before replacing a hydraulic tappet for noisy operation, be sure the noise is not caused by improperly adjusted valve to rocker arm clearance or by worn rocker arms or push rods.

Removal

1. Remove the intake manifold and related parts following procedures given in Intake Manifold Removal in this Part.
2. Disconnect thermactor air supply hose at the air pump and place it out of the way.
3. Remove the valve rocker arm cover, then loosen the valve rocker arm fulcrum bolts (Fig. 12) and rotate the rocker arms to the side.
4. Remove the valve push rods in sequence so that they can be installed in their original positions.

5. Using Tool T70L-6500-A or equivalent shown in Fig. 21, remove the tappets and place them in a rack so that they can be installed in their original bores.

If necessary to disassemble a tappet, refer to Tappet Disassembly and Assembly in this Part.

Installation

Tappets and bores are to be lubricated with heavy engine oil SE before installation.

1. Clean the external surfaces and install the tappets in the bores from which they were removed, using Tool T70L-6500-A or equivalent. If a new tappet(s) is being installed, check the new tappet(s) for a free fit in the bore in which it is to be installed. Lubricate the tappet(s) and bore(s) with heavy engine oil before inserting the tappet.
2. Lubricate the ends of the push rods with Lubriplate or equivalent and install the push rods in their original positions. Apply Lubriplate or equivalent to the valve stem tip.
3. Lubricate the rocker arms and fulcrum seats with Lubriplate or equivalent and position the rocker arms over the push rods. Tighten rocker arm fulcrum bolts to specification.
4. Install the valve rocker arm covers.
5. Reconnect thermactor air supply hose.
6. Install the intake manifold following instructions given under Intake Manifold Installation in this Part.

CYLINDER HEADS

If a cylinder head is to be replaced, follow the procedures under Cylinder Head Disassembly and

Assembly in this Part, and transfer all valves, springs, spark plugs, etc., to the new cylinder head. Clean and inspect all parts, reface the valves (refer to Part 21-01) and check all assembly clearances before assembling the new or used parts to the new cylinder head.

Removal

1. Remove the intake manifold and carburetor as an assembly, following the procedure under Intake Manifold Removal in this Part.
2. Remove the rocker arm cover(s).
3. If the right cylinder head is to be removed, loosen the alternator and air pump adjusting arm bolt and remove the alternator and air pump mounting bracket bolt and spacer. Swing the alternator down and out of the way. Remove the ignition coil (E-100—E-350) and air cleaner inlet duct from the right cylinder head assembly.

If the left cylinder head is being removed, remove the bolts fastening the air conditioning compressor bracket at the front of the cylinder head on all F series, remove oil dipstick and tube assembly and speed control bracket, if so equipped.

4. Disconnect the exhaust manifold(s) from the muffler inlet pipe(s).
5. Loosen the rocker arm fulcrum bolts so that the rocker arms can be rotated to the side. Remove the push rods in sequence (Fig. 22) so that they may be installed in their original positions.

E-100—F-100/150/250/BRONCO

Remove the bolts holding the thermactor air supply manifold to the rear of the cylinder head and disconnect the hose at the air pump. Remove hose, pump valve and air supply manifold as an assembly.

F-100—F-250, BRONCO

Disconnect the thermactor air supply hoses at the check valves and plug the check valves.

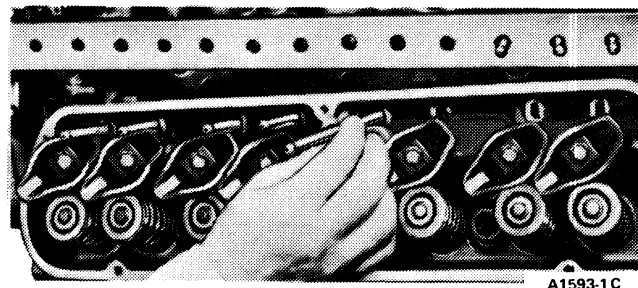


FIG. 22 Removing Valve Push Rods

6. Remove the exhaust valve stem caps.
7. Install the cylinder head holding fixtures (Fig. 23). Remove the cylinder head attaching bolts and lift the cylinder head off the block. Remove and discard the cylinder head gasket.

Installation

1. Clean the cylinder head, intake manifold, valve rocker arm cover and cylinder head gasket surfaces. If the cylinder head was removed for a cylinder head gasket replacement, check the

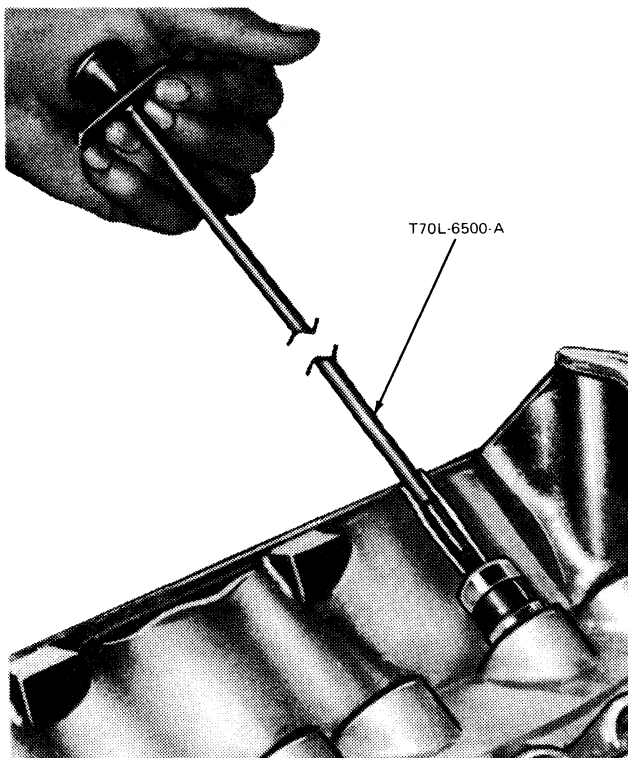


FIG. 21 Removing Valve Tappet

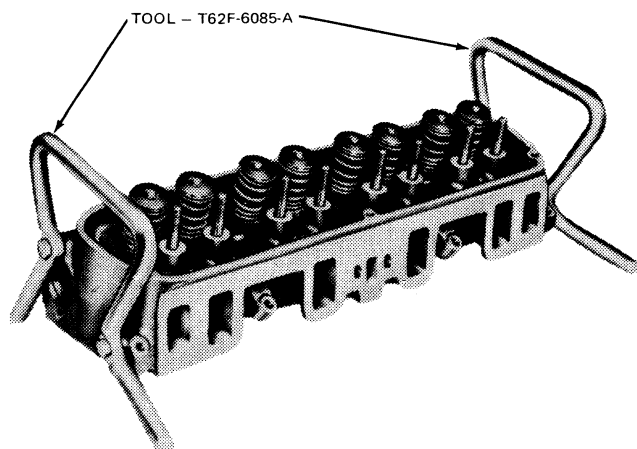


FIG. 23 Cylinder Head Holding Fixtures

flatness of the cylinder head and block gasket surfaces (refer to Part 21-01, General Gasoline Engine Service).

2. A specially treated composition gasket is used. **Do not apply sealer to a composition gasket. Position the new cylinder head gasket over the cylinder dowels on the block. Position the cylinder head on the block and install the attaching bolts. Remove the holding fixtures.**
3. The cylinder head bolts are tightened in three progressive steps. Tighten all the bolts in sequence (Fig. 24) to specifications. When cylinder head bolts have been tightened following this procedure, it is not necessary to re-tighten the bolts after extended operation. However, the bolts may be checked and re-tightened if desired.

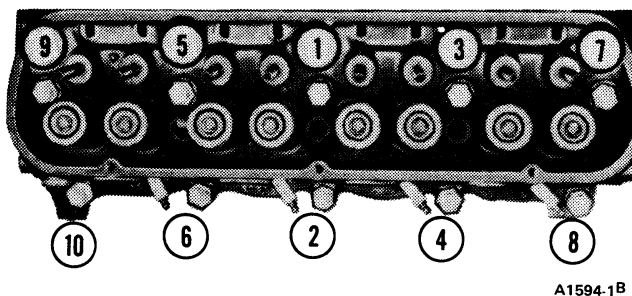


FIG. 24 Cylinder Head Bolt Tightening Sequence

4. Clean the push rods in a suitable solvent. Blow out the oil passage in the push rod with compressed air. Check the ends of the push rods for nicks, grooves, roughness or excessive wear. Visually check the push rods for straightness or check push rod runout with a dial indicator (refer to Part 21-01, General Gasoline Engine Service). If runout exceeds the maximum limit at any point, discard the rod. **Do not attempt to straighten push rods.**
5. Lubricate the end of the push rods with Lubriplate or equivalent and install them in their original positions. Apply Lubriplate or equivalent to the valve stem tips. Install the exhaust valve stem cap.

6. Lubricate the rocker arms and fulcrum seats with Lubriplate or equivalent, then install the rocker arms.
7. Position a new gasket(s) on the muffler inlet pipe(s). Connect the exhaust manifold(s) at the muffler inlet pipe(s). Tighten the nuts to specifications (refer to Part 26-01, General Exhaust System Service).
8. If the right cylinder head was removed, swing the air pump into position and install the alternator attaching bolt and spacer, ignition coil (E-100—E-350) and air cleaner inlet duct on the right cylinder head. Adjust the drive belt tension to specifications.
If the left cylinder head was removed, install the air conditioning compressor bracket, if so equipped, at the front of the cylinder head. Install the oil dipstick and tube assembly and speed control bracket, if so equipped.
9. Clean the valve rocker arm cover and cylinder head gasket surfaces. Place the new gaskets in the covers making sure that the tabs of the gasket engage the notches provided in the cover. Install the valve rocker arm cover(s).
10. Install the intake manifold and related parts, following the procedure under Intake Manifold Installation in this Part.
11. Install the thermactor air supply manifold at the rear of the cylinder heads and reconnect. The air supply hose to the air pumps (F-100/150) unplug the check valves and connect the thermactor air supply hose.

EXHAUST MANIFOLDS

Removal

1. Remove air cleaner and intake duct assembly, including the crankcase ventilation hose.
2. Remove bolts attaching the air cleaner inlet duct (F-100—F-250, Bronco).
3. Disconnect muffler inlet pipes.
4. Remove attaching bolts and flat washers. On the left hand exhaust manifold remove oil dipstick tube assembly and speed control bracket, if so equipped, then remove the exhaust manifold.

Installation

1. Clean the mating surfaces of the exhaust manifold(s) and cylinder head(s). Clean the mounting flange of the exhaust manifold(s) and muffler inlet pipe(s).
2. Position the exhaust manifold(s) on the cylinder head(s) and install attaching bolts and flat washers. On the left hand exhaust manifold install oil dipstick tube assembly and the speed control bracket, if so equipped. Working from the center to the ends, tighten the bolts to specifications.
3. Place a new gasket(s) on the muffler inlet pipe(s). Position the muffler inlet pipe(s) into the manifold(s). Install and tighten the attaching nuts to specifications (refer to Part 26-01, General Exhaust System Service).
4. Position the air cleaner inlet duct (F-100 vehicles only). Install and tighten attaching bolts to specifications.
5. Install air cleaner and intake duct assembly, including the crankcase ventilation hose.

WATER PUMP

F-100—F-250/BRONCO

Removal

1. Drain the cooling system. Refer to Part 27-02, General Cooling System Service.
2. Remove the bolts securing the fan shroud to the radiator, if so equipped. Position the shroud over the fan.
3. Disconnect the radiator lower hose, heater hose and by-pass hose at the water pump. Remove the drive belts, fan, fan spacer and pulley.
Remove the fan shroud, if so equipped.
4. Loosen the alternator pivot bolt and bolt attaching the alternator adjusting arm to water pump.
5. Remove the bolts securing the water pump to cylinder front cover. Remove the water pump.

Installation

Before a water pump is re-installed, check it for damage. If it is damaged, replace it.

1. Remove all gasket material from the mounting surfaces of the cylinder front cover and water pump.
2. Position a new gasket, coated on both sides with sealer, on the cylinder front cover; then, install the pump.
3. Install the attaching bolts and tighten to specifications.
4. Install the alternator pivot bolt and bolt attaching the alternator adjusting arm to the water pump.
5. Position the fan shroud over the water pump, if so equipped. Install the pulley, spacer and fan. Install and adjust the drive belts to the specified belt tension (refer to specifications at end of this Part). Connect the radiator hose, heater hose and by-pass hose.
Install the fan shroud bolts, if so equipped.
6. Fill and bleed the cooling system (refer to Part 27-02, General Cooling System Service). Operate the engine until normal operating temperatures have been reached and check for leaks.

E-100—E-250

Removal

1. Remove the air cleaner and intake duct assembly, including the crankcase ventilation hose.
2. Drain the cooling system. Refer to Part 27-02, General Cooling System Service.
3. Disconnect the radiator upper hose at the engine and lower hose at the radiator. Remove the radiator attaching bolts and nuts. Remove the radiator (refer to Part 27-04).
4. Remove drive belts, fan, spacer and water pump pulley.
5. Disconnect heater hose and by-pass hose at water pump.
6. Remove the bolts securing the water pump to the cylinder front cover. Remove the water pump.

Installation

Before a water pump is re-installed, check it for damage. If it is damaged, replace it.

1. Remove all gasket material from the mounting surfaces of the cylinder front cover and water pump.
2. Position a new gasket, coated on both sides with sealer, on the cylinder front cover; then, install the pump.
3. Install the attaching bolts and tighten to specifications.
4. Connect the heater hose and by-pass hose at the water pump.
5. Install the water pump pulley, spacer and fan drive belts.
6. Install the radiator (refer to Part 27-04), connecting lower hose at the radiator and upper hose at the engine.
7. Fill and bleed the cooling system (refer to Part 27-02, General Cooling System Service). Operate the engine until normal operating temperatures have been reached and check for leaks.
8. Install the air cleaner and intake duct assembly, including the crankcase ventilation hose.

CYLINDER FRONT COVER AND TIMING CHAIN

F-100 AND F-250/BRONCO

Removal

1. Refer to Water Pump Removal in this Part. Perform all steps except removal of the pump. Leave it attached to the front cover.
2. Remove the crankshaft pulley from the crankshaft vibration damper. Remove the damper attaching bolt and washer. Install the puller on the crankshaft vibration damper (Fig. 25) and remove the vibration damper.

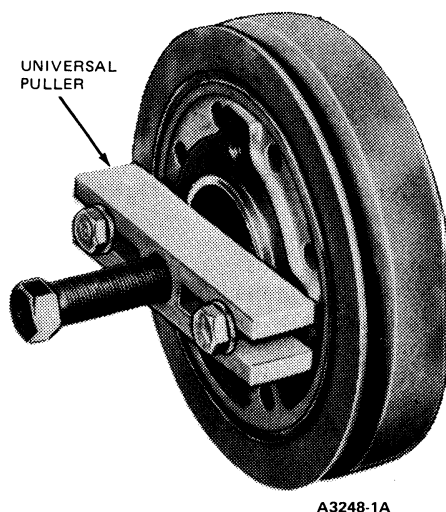


FIG. 25 Crankshaft Vibration Damper Removal—F-100 and F-250, Bronco

3. Disconnect the fuel pump outlet line from the fuel pump. Remove the fuel pump to one side with the flexible fuel lines still attached.
4. Remove the oil pan-to-cylinder front cover attaching bolts. Use a thin bladed knife to cut the oil pan gasket flush with the cylinder block face prior to separating the cover from the cylinder block. Remove the cylinder front cover and water pump as an assembly.
5. Discard the cylinder front cover gasket
6. Check the timing chain deflection using the procedure given in Part 21-01. If deflection exceeds specifications listed at the end of this Part replace the chain and sprockets.
7. Crank the engine until the timing marks on the sprockets are positioned as shown in Fig. 26.

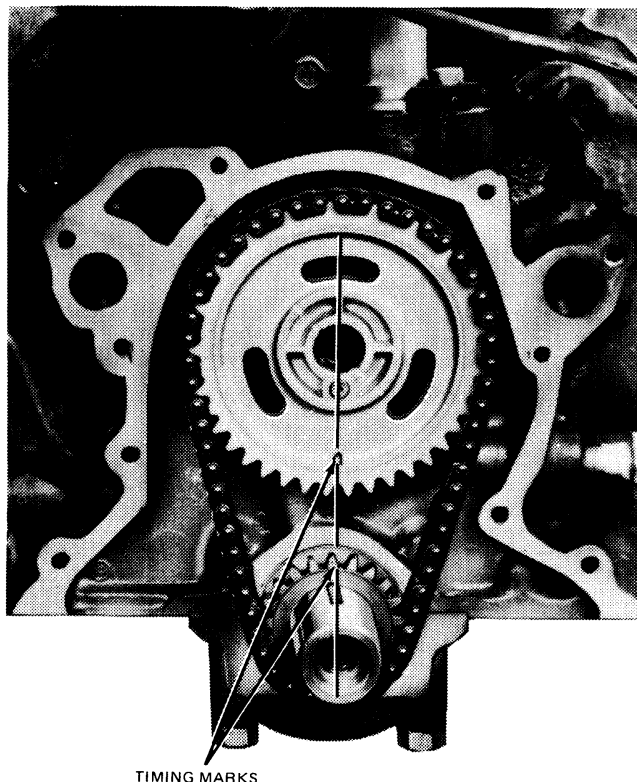


FIG. 26 Aligning Timing Marks

8. Remove the camshaft sprocket capscrew, washers and fuel pump eccentric. Slide both sprockets and the timing chain forward, and remove them as an assembly (Fig. 27).

Installation

1. Position the sprockets and timing chain on the camshaft (Fig. 27). Be sure the timing marks on the sprockets are positioned as shown in Fig. 26.
2. Install the fuel pump, eccentric, washers and camshaft sprocket capscrew (Fig. 28). Tighten the sprocket capscrew to specifications.
3. Clean the cylinder front cover, oil pan and the block gasket surfaces. Clean the oil pan gasket surface where the oil pan and front cover fasten (Fig. 28).
Install a new oil seal, following procedures under Front Oil Seal Removal and Installation.

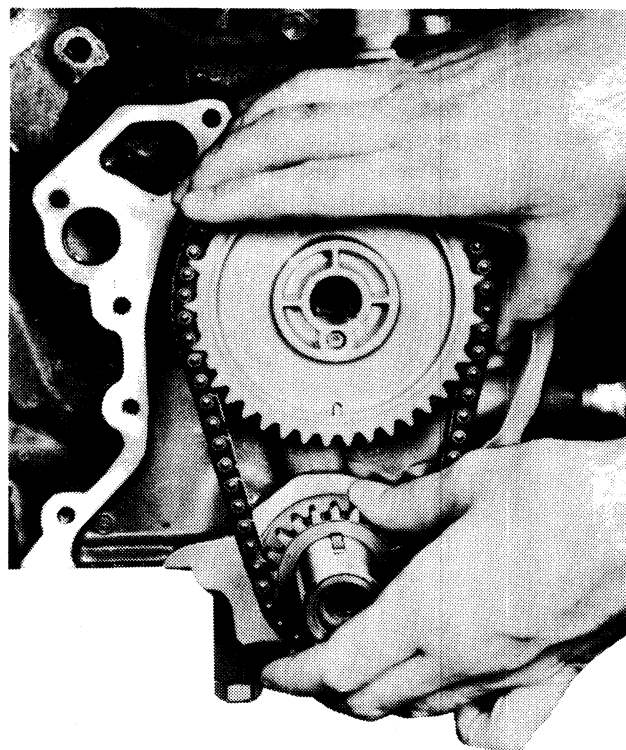


FIG. 27 Removing or Installing Timing Chain

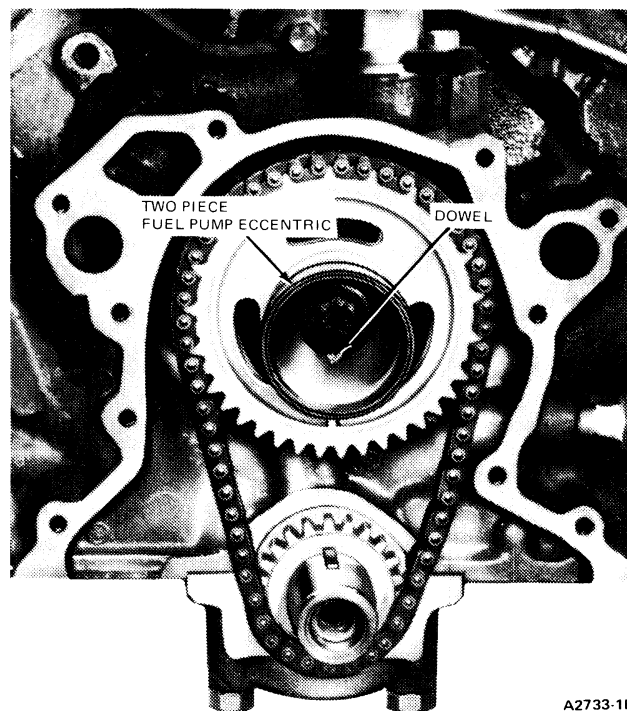


FIG. 28 Fuel Pump Eccentric—Installed

4. Lubricate the timing chain and sprockets with heavy engine oil. Apply heavy engine oil SE to the fuel pump eccentric.
5. Coat the gasket surface of the oil pan with sealer, then cut and position the required sections of a new gasket on the oil pan and apply sealer at the corners. Install the pan seal as required. Coat the

gasket surfaces of the block and cover with sealer, and position a new gasket on the block.

6. Position the cylinder front cover on the cylinder block. Use care when installing the cover to avoid seal damage or possible gasket mislocation.
7. Install the cylinder front cover-to-seal alignment tool into proper position (Fig. 29).

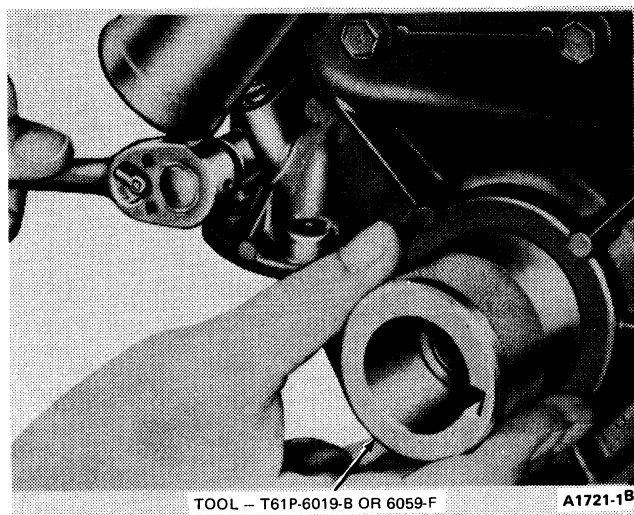


FIG. 29 Aligning Cylinder Front Cover

8. It may be necessary to force the cover downward to slightly compress the pan gasket. This operation can be facilitated by using a suitable tool at the front cover attaching hole locations.
9. Coat the threads of the attaching screws with oil-resistant sealer and install the screws. While pushing in on the alignment tool, tighten the oil pan to cover attaching screws to specifications. Tighten the cover to block attaching screws to specifications. Remove the alignment tool.
10. Apply Lubriplate or equivalent to the oil seal rubbing surface of the vibration damper inner hub to prevent damage to the seal and to the front of the crankshaft for damper installation.
11. Line up the crankshaft vibration damper keyway with the key on the crankshaft. Install the vibration damper on the crankshaft (Fig. 30). Install the capscrew and washer. Tighten the screw to specifications. Install the crankshaft pulley.
12. Lubricate the fuel pump lever with heavy engine oil and install the fuel pump using a new gasket. Connect the fuel pump outlet pipe.
13. Complete the remaining operations given under Water Pump Installation.
14. Fill and bleed the cooling system. Refer to Part 27-02, General Cooling System Service.
15. Operate the engine at fast idle and check the coolant level and check for oil leaks. Check and adjust the ignition timing to specifications on engine decal.
16. Install the air cleaner and intake duct assembly, including the crankcase ventilation hose.

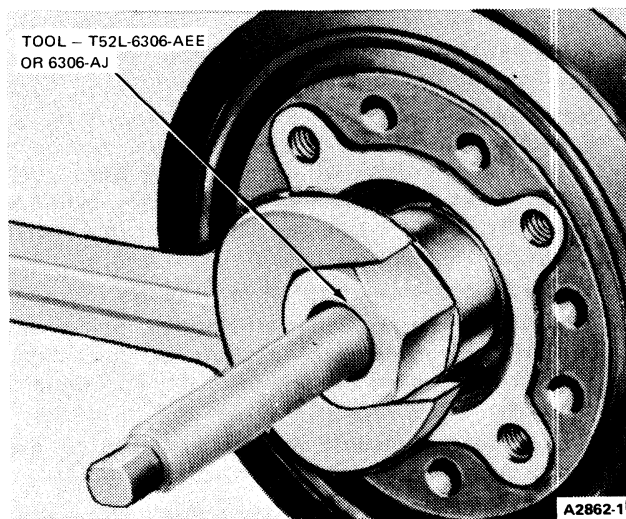


FIG. 30 Installing Crankshaft Vibration Damper

E-100—E-250

Removal

1. Drain radiator. If so equipped, remove AC idler pulley and bracket and remove belt (refer to Group 36).
2. Remove upper radiator hose. Remove fan and shroud as an assembly. Raise vehicle on hoist.
3. Loosen thermactor and alternator and remove drive belt.
4. Disconnect radiator lower hose at water pump. Disconnect fuel line at fuel pump and remove pump. Lower vehicle on hoist.
5. Remove by-pass hose. If so equipped, remove power steering belt. Remove water pump pulley and disconnect heater hose at pump.
6. If so equipped, remove AC compressor upper bracket. Remove power steering pump mount from AC compressor and water pump.
7. Remove crankshaft pulley. Remove oil pan to front cover bolts. Remove front cover and water pump as an assembly.
8. Discard the cylinder front cover gasket.
9. Check the timing chain deflection using the procedure given in Part 21-01. If deflection exceeds specifications listed at the end of this Part, replace the chain and sprockets.
10. Crank the engine until the timing marks on the sprockets are positioned as shown in Fig. 26.
11. Remove the camshaft sprocket capscrew, washers and fuel pump eccentric. Slide both sprockets and the timing chain forward, and remove them as an assembly (Fig. 27).
12. Clean front cover, fuel pump and damper. Lubricate seal. Clean gasket surface at pan and trim gasket. Clean front cover gasket surface at block.

Installation

1. Position the sprockets and timing chain on the camshaft (Fig. 27). Be sure the timing marks on the sprockets are positioned as shown in Fig. 28.

2. Install the fuel pump, eccentric, washers and camshaft sprocket capscREW. Tighten the sprocket capscREW to specifications.
3. Replace oil seal in front cover. Position gasket to front cover. Apply RTV silicone sealer to oil pan and cylinder block junction. Cut pan gasket, then position to pan and front cover.
4. Install front cover. Install fuel pump. Install crankshaft pulley and water pump.
5. If so equipped, install power steering pump. Install by-pass hose and connect heater hose.
6. If so equipped, install AC compressor upper bracket. Install water pump pulley. If so equipped, position power steering belt.
7. Position alternator belt. Position thermactor pump belt. Install fan and shroud.
8. If so equipped, adjust power steering belt tension. If so equipped, install AC idler pulley and bracket. Position belt and adjust tension following Specifications listed at the end of this Part.
9. Install radiator upper hose. Raise vehicle on hoist. Connect fuel lines at pump.
10. Connect radiator lower hose. Adjust alternator, thermactor pump and belt tension following Specifications listed at the end of this Part. Drain crankcase. Replace oil filter.
11. Lower vehicle on hoist. Fill crankcase and cooling system (refer to Part 27-02, General Cooling System Service). Start engine and check for leaks.
12. Adjust engine timing to specification on engine decal.

FRONT OIL SEAL

Removal

1. Remove the cylinder front cover.
2. Drive out the old seal with a pin punch.

Installation

1. Coat a new seal with grease, then install the seal in the cover (Fig. 31). Drive the seal in until it is fully seated in the recess.

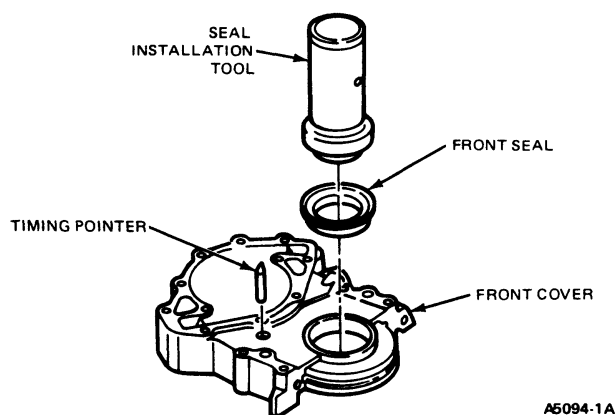


FIG. 31 Installing Crankshaft Front Oil Seal

CAMSHAFT

The camshaft and related parts are shown in Fig. 32.

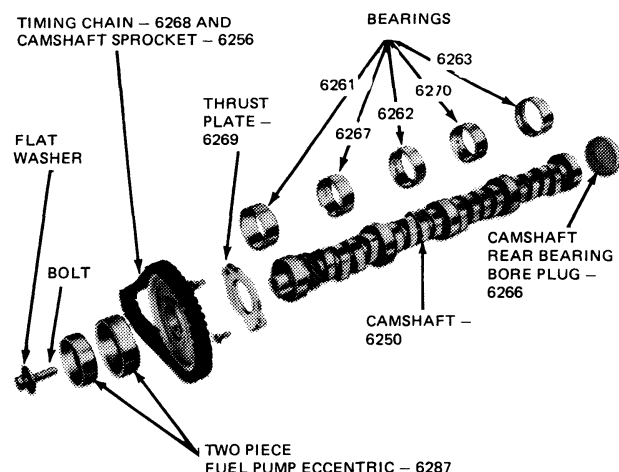


FIG. 32 Camshaft and Related Parts

Removal

1. On E-100—E-250 vehicles only, remove the grille.
2. Drain the cooling system (refer to Part 27-02, General Cooling Systems Service). Disconnect the radiator upper and lower hoses. Disconnect the transmission oil cooler lines, if so equipped. Remove the radiator (Refer to Part 27-04).
3. Remove the cylinder front cover and the timing chain, following the procedure under Cylinder Front Cover and Timing Chain Removal in this Part.
4. Remove the intake manifold and carburetor as an assembly, following the procedures under Intake Manifold Removal in this Part.
5. Remove the tappets following the procedure given under Tappet Removal in this Part.
6. Remove the camshaft thrust plate. Carefully remove the camshaft by pulling toward the front of the engine. **Use caution to avoid damaging the camshaft bearings.**

Installation

1. Oil the camshaft journals and apply Lubriplate or equivalent to the lobes. Carefully slide the camshaft through the bearings. Lubricate the camshaft thrust plate with heavy engine oil SE and install the camshaft thrust plate with the groove toward the cylinder block.
2. Lubricate the tappets and tappet bore with heavy engine oil. Install the valve tappets in the bores from which they were removed, using Tool T70L-6500-A or equivalent.
3. Lubricate the ends of the push rods with Lubriplate or equivalent and install the push rods in their original positions. Apply Lubriplate or equivalent to the valve stem tips. Lubricate the rocker arms and fulcrum seats with Lubriplate or equivalent and position the rocker arms over the push rods. Tighten bolts to specification.
4. Install the intake manifold and related parts by following the steps under Intake Manifold Installation in this Part.
5. Replace the crankshaft front oil seal. Install the timing chain, cylinder front cover and related parts,

following the steps under Cylinder Front Cover and Timing Chain Installation in this Part.

6. Perform a valve clearance adjustment as outlined in this Part.
7. Install the valve rocker arm covers, following the special procedures given under Valve Rocker Arm Cover Installation in this Part.
8. Clean and install the crankcase ventilation system.
9. Install the radiator (refer to Part 27-04), and connect the hoses. Connect the oil cooler lines, if so equipped.
10. Fill and bleed the cooling system (refer to Part 27-02, General Cooling System Service). Fill the crankcase with the proper grade and quantity of engine oil.
11. Start the engine, then check and adjust the ignition timing (refer to the Engine Decal for correct settings). Connect the distributor and intake manifold vacuum hoses.
12. Operate the engine at fast idle and check all hose connections and gaskets for leaks. Operate the engine until engine temperatures have stabilized, then adjust the engine idle speed and idle fuel mixture (refer to specifications on engine decal). Retighten intake manifold bolts and nuts to specifications.
13. Install the air cleaner and intake duct assembly, including the crankcase ventilation hose.
14. On E-100—E-250 vehicles, install the grille.

FLYWHEEL

Removal

1. On a vehicle with a manual-shift transmission, remove the clutch pressure plate and disc following the procedures in Group 16.
On a vehicle with an automatic transmission, remove the transmission and converter housing following the procedure in Group 17.
2. To check flywheel face runout or to replace a flywheel ring gear for a manual-shift transmission, refer to Part 21-01.
3. Remove the flywheel attaching bolts and remove the flywheel.

Installation

1. Coat the threads of the flywheel attaching bolts with oil-resistant sealer. Position the flywheel on the crankshaft flange. Install and tighten the bolts in sequence across from each other to specifications.
2. On a vehicle with a manual-shift transmission, check the flywheel runout, following the procedure in Part 21-01. Install the clutch pressure plate, disc and the transmission, following the procedures in Group 16.

On a vehicle with an automatic transmission, check the flywheel runout, following the procedure in Part 21-01. Install the transmission and converter housing, following the procedure in Group. 17.

CLUTCH PILOT BEARINGS

Removal

A needle roller bearing and adaptor assembly is used as a clutch pilot bearing on E-100—E-250, F-100—F-

250 and Bronco vehicles (Fig. 33). It is inserted directly into the engine crankshaft. The bearing and adaptor assembly is used with the bearing and adaptor comprising an assembly that cannot be serviced separately. The needle bearing clutch pilot can only be installed with the seal end of the bearing facing the transmission. The bearing and seal are pre-greased and do not require additional lubrication. A new bearing must be installed whenever a bearing is removed.

Removal

1. Remove the transmission, clutch pressure plate, and disc following the procedures in Group 16.
2. Using Tools T59L-100B and T58L-101-A or equivalent, remove the pilot bearing (Fig. 34).

Installation

1. Using Tool-7600-H or equivalent, install the pilot bearing with the seal facing the transmission (Fig. 35) so that the adaptor is not cocked.
2. Install the clutch pressure plate, disc, and transmission following the procedure in Group 16.

NOTE: Care must be taken not to damage the bearing during transmission installation while the transmission input shaft is being inserted into the bearing.

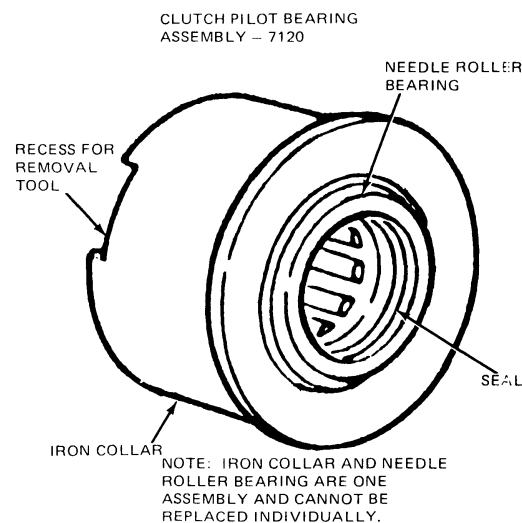


FIG. 33 Needle Pilot Bearing Assembly

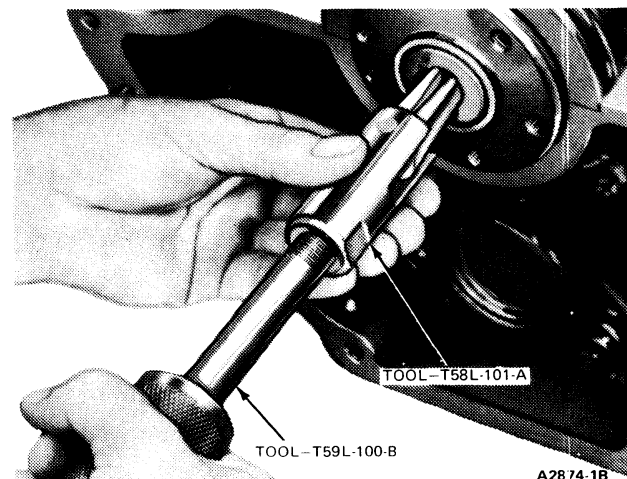


FIG. 34 Removing Clutch Pilot Bearing

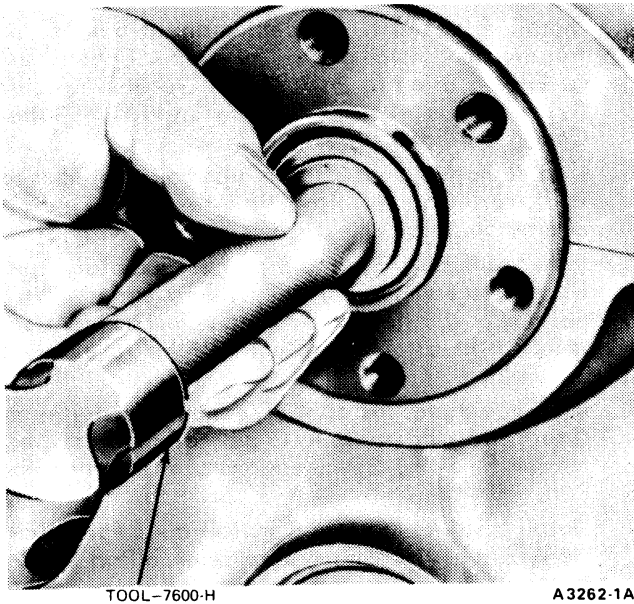


FIG. 35 Installing Clutch Pilot Bearing

CAMSHAFT REAR BEARING BORE PLUG

Removal

1. Remove the transmission, clutch pressure plate and disc, following the procedures in Group 16.
On a vehicle with an automatic transmission, remove the transmission and converter housing following the procedure in Group 17.
2. Remove the flywheel attaching bolts and remove the flywheel. Remove the engine rear cover plate.
3. Replace the rear bearing bore plug as detailed in Part 21-01.

Installation

1. Coat the flywheel attaching bolts with oil-resistant sealer. Position the engine rear cover plate on the cylinder block dowels. Position the flywheel on the crankshaft flange. Install and tighten the attaching bolts in sequence, across from each other, to specifications.
2. On a vehicle with a manual-shift transmission, install the clutch pressure plate, disc and the transmission following the procedures in Group 16.
3. On a vehicle with an automatic transmission, install the transmission and converter housing, following the procedure in Group 17.

OIL PAN

F-100 AND/F-250/BRONCO

Removal

1. Remove the oil dipstick (on pan entry models only).
2. Remove the bolts attaching the fan shroud to the radiator and position the shroud over the fan.
3. Remove the nuts and lockwashers attaching the engine support insulators to the chassis bracket.
4. If equipped with an automatic transmission, disconnect the oil cooler line at the left side of the radiator.

5. Raise the engine and place wood blocks under the engine supports.
6. Drain the crankcase.
7. Remove the oil pan attaching bolts and lower the oil pan onto the crossmember.
8. Remove the two bolts attaching the oil pump pick-up tube to the oil pump. Remove nut attaching oil pump pickup tube to the number 3 main bearing cap stud. Lower the pick-up tube and screen into the oil pan.
9. Remove the oil pan from the vehicle.

Installation

1. Clean oil pan, inlet tube and gasket surfaces. Inspect the gasket sealing surface for damages and distortion due to overtightening of the bolts. Repair and straighten as required.
2. Position a new oil pan gasket and seals to the cylinder block (Fig. 36).

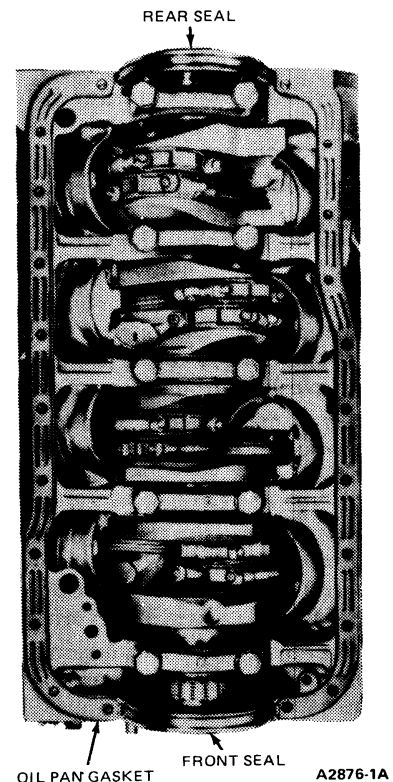


FIG. 36 Oil Pan Gaskets and Seals Installed

3. Position the oil pick-up tube and screen to the oil pump, and install the lower attaching bolt and gasket loosely. Install nut attaching to number 3 main bearing cap stud.
4. Place the oil pan on the crossmember. Install the upper pick-up tube bolt. Tighten the pick-up tube bolts to specifications.
5. Position the oil pan to the cylinder block and install the attaching bolts. Tighten to specifications.
6. Raise the engine and remove the wood blocks. Lower the engine and install the insulator-to-chassis bracket nuts and washers. Tighten the nuts to specifications.

7. If equipped with an automatic transmission, connect the oil cooler line at the radiator.
8. Install the fan shroud attaching bolts.
9. Fill the crankcase with the proper grade and quantity of engine oil. Install the oil dipstick. Start the engine and operate it until it reaches normal operating temperature, then check for leaks.

E-100—E-250

Removal

1. Open hood and disconnect battery. Open door and remove engine cover. Remove air cleaner. Drain cooling system (refer to Part 27-02, General Cooling System Service).
2. If so equipped, loosen power steering pump and remove belt. Remove power steering pump from mount and position out of way. If so equipped, remove A/C compressor retainers and position compressor out of way.
3. Disconnect radiator upper hose. Remove fan shroud bolts and oil filler tube. Remove oil dipstick to exhaust manifold bolt. Raise vehicle on hoist.
4. Remove splash shield under alternator. If so equipped, disconnect transmission cooler lines at radiator. Disconnect radiator lower hose.
5. Disconnect fuel line at pump. Remove engine mount nuts. Drain crankcase. Remove the dipstick tube from oil pan. Disconnect muffler inlet pipe from manifolds.
6. If so equipped, remove automatic transmission dipstick and tube. Disconnect manual linkage at transmission. Remove center driveshaft support and remove driveshaft from transmission.
7. Place a transmission jack under the oil pan and insert a wooden block between the pan and jack. **The engine and transmission assembly will pivot around the rear engine mount. The engine assembly must be raised four inches measured from the front motor mounts. The engine must remain centered in the engine compartment to obtain this much lift.**
8. Raise the engine and transmission assembly. Insert wood blocks to support engine in uppermost position.
9. Lower oil pan. Unbolt the oil pump and pick-up tube and lay in pan. Install nut attaching pickup tube to number 3 main bearing cap stud. Remove oil pan from vehicle.

Installation

1. Clean oil pan, pick-up tube, pump and gasket surfaces. Inspect gasket sealing surfaces for damage or distortion from overtightened bolts.
2. Position new gasket and seals to block. Position pan with pump to vehicle and install pump. Install nut attaching pickup tube to number 3 main bearing cap stud. Install oil pan and tighten attaching bolts to specifications. Install dipstick tube.
3. Position transmission jack, raise engine, remove wood blocks, lower engine and remove jack. Install front insulator attaching nuts and tighten to specifications.

4. Install driveshaft. Connect manual linkage at transmission. Install muffler inlet pipe. Tighten nuts to Specification to Part 26-01, General Exhaust System Service. Install transmission filler tube. Connect radiator lower hose.
5. If so equipped, connect transmission cooler lines to radiator. Connect fuel line to pump. Install alternator splash shield. Lower vehicle on hoist.
6. Install radiator shroud and connect radiator upper hose. If so equipped, install power steering pump. Position power steering belt and adjust belt tension. Install bolt attaching dipstick tube to exhaust manifold.
7. If so equipped, install A/C compressor (refer to Group 36). Position A/C belt and adjust belt tension following Specifications at the end of this Part.
8. Install oil filler tube and install air cleaner. Fill crankcase and cooling system (refer to Part 27-02, General Cooling System Service).
9. Connect battery. Start engine and check for leaks. Install engine cover. Close hood and door.

OIL PUMP

Removal

Note: On E-100 — E-250 vehicles the oil pump and oil pan must be removed and installed together. Refer to the E-100 — E-250 Oil Pan Removal and Installation procedures in this Part.

F-100—F-250 AND BRONCO

1. Remove the oil pan and related parts as outlined under Oil Pan Removal.
2. Remove the oil pump inlet tube and screen assembly.
3. Remove the oil pump attaching bolts (Fig. 37), and remove the oil pump gasket and intermediate drive shaft.

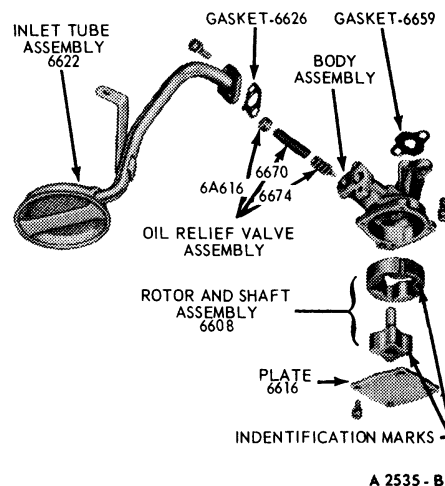


FIG. 37 Oil Pump and Inlet Tube

Installation

1. Prime the oil pump by the inlet port with engine oil. Rotate the pump shaft to distribute the oil within the pump body.

2. Position the intermediate drive shaft into the distributor socket. With the shaft firmly seated in the distributor socket, the stop on the shaft should touch the roof of the crankcase. Remove the shaft and position the stop as necessary.
3. With the stop properly positioned, insert the intermediate drive shaft into the oil pump. Install the pump and shaft as an assembly. **Do not attempt to force the pump into position if it will not seat readily. The drive shaft hex may be misaligned with the distributor shaft. To align, rotate the intermediate drive shaft into a new position.** Tighten the oil pump attaching screws to specifications.
4. Clean and install the oil pump inlet tube and screen assembly.
5. Install the oil pan and related parts as outlined under Oil Pan Installation.

CRANKSHAFT REAR OIL SEAL

Replacement of a crankshaft rear oil seal because of oil leakage requires replacement of both the upper and lower seals. Refer to Crankshaft Rear Oil Seal Replacement in Part 21-01 for special replacement procedures.

MAIN BEARING

The main bearing inserts are selective fit. Refer to the procedures under Fitting Main and Connecting Rod Bearings in Part 21-01.

Removal

1. Drain the crankcase. Remove the oil level dipstick. Remove the oil pan and related parts, following the procedure under Oil Pan Removal in this Part.
2. Remove the oil pump inlet tube assembly and the oil pump.
3. Replace one bearing at a time, leaving the other bearings securely fastened. Remove the main bearing cap to which new bearings are to be installed.
4. Insert the upper bearing removal tool (Tool 6331) or equivalent in the oil hole in the crankshaft (Fig. 38).
5. Rotate the crankshaft in the direction of engine rotation to force the bearing out of the block.
6. Clean each crankshaft journal. Inspect the journals and thrust faces (thrust bearing) for nicks, burrs or bearing pick-up that would cause premature bearing wear.
7. If the rear main bearing is being replaced, remove and discard the rear oil seal from the bearing cap.
8. Remove the block half of the rear oil seal following the procedures given under Crankshaft Rear Oil Seal Removal, Part 21-01.

Installation

1. If the rear main bearing is being replaced, clean the rear oil seal groove in the block with a brush and solvent.
2. Install the block half of the rear oil seal following the procedures given under Crankshaft Rear Oil Seal Installation, Part 21-01.

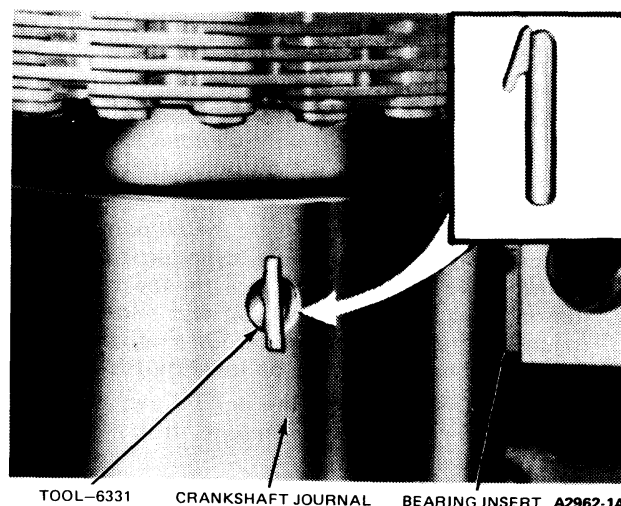


FIG. 38 Removing or Installing Upper Main Bearing Insert

3. To install an upper main bearing, place the plain end of the bearing over the shaft on the locking tang side of the block and partially install the bearing so that Tool 6331 or equivalent can be inserted in the oil hole in the crankshaft (Fig. 38). With Tool 6331 or equivalent positioned in the oil hole in the crankshaft, rotate the crankshaft in the opposite direction of engine rotation until the bearing seats itself. Remove the tool.
4. Install the bearing cap.
5. Select fit the bearing for proper clearance, following the procedures under Fitting Main and Connecting Rod Bearings in Part 21-01.
6. If the bearing is being replaced on journal number 1, 2 or 4, apply a coat of heavy engine oil SE to the journal and bearings and install the bearing cap. Tighten the cap bolts to specifications.
7. If the rear main bearing is to be replaced, remove the rear main oil seal retaining pin from the lower bearing cap seal groove. The pin is not used with the split, lip-type seal.
Clean the oil seal groove with a brush and solvent.
8. Install the lower seal in the rear main bearing cap with the undercut side of the seal toward the FRONT of the engine (Fig. 36). Allow the seal to protrude approximately 3/8 inch above the parting surface to mate with the upper seal when the cap is installed.
9. Refer to Part 21-01 for special instructions in applying RTV sealer to the rear main bearing cap. Lubricate the journal with heavy engine oil SE and install the rear main bearing cap. Tighten the cap bolts to specifications.
10. If the thrust bearing cap (No. 3 main bearing) has been removed, install it as follows:
Lubricate the journal with heavy engine oil SE and install the thrust bearing cap with the bolts finger tight. Pry the crankshaft forward against the thrust surface of the upper half of the bearing. Hold the crankshaft cap to the rear. This will align the

thrust surfaces of both halves of the bearing. Retain the forward pressure on the crankshaft. Tighten the cap bolts to specifications (Fig. 39).

11. Clean the oil pump inlet tube screen. Prime the oil pump by filling the inlet opening with oil and rotating the pump shaft until oil emerges from the outlet opening. Install the oil pump and inlet tube assembly.
12. Position the oil pan gaskets on the oil pan. Position the oil pan front seal on the cylinder front cover. Position the oil pan rear seal on the rear main bearing cap. Install the oil pan and related parts, following the procedure under Oil Pan Installation in this section. Install the oil level dipstick.
13. Fill the crankcase. Start the engine and check for oil pressure. Operate the engine at fast idle and check for oil leaks.

CONNECTING ROD BEARINGS

The connecting rod bearings are selective fit. Refer to the procedures under Fitting Main and Connecting Rod Bearings in Part 21-01.

Removal

1. Drain the crankcase. Remove the oil level dipstick. Remove the oil pan and related parts, following the procedure under Oil Pan Removal.
2. Remove the oil pump inlet tube assembly and the oil pump.
3. Turn the crankshaft until the connecting rod to which new bearings are to be fitted is down. Remove the connecting rod cap. Remove the bearing inserts from the rod and cap.

Installation

1. Be sure the bearing inserts and the bearing bore in the connecting rod and cap are clean. Foreign material under the inserts will distort the bearing and cause a failure.
2. Clean the crankshaft journal.
3. Install the bearing inserts in the connecting rod and cap with the tangs fitting in the slots provided.

4. Pull the connecting rod assembly down firmly on the crankshaft journal.
5. Select fit the bearing, following procedures under Fitting Main and Connecting Rod Bearings in Part 21-01.
6. After the bearing has been fitted, clean and apply a coat of heavy engine oil SE to the journal and bearings. Install the connecting rod cap. Tighten the nuts to specifications.
7. Repeat the procedure for the remaining connecting rods that require new bearings.
8. Clean the oil pump inlet tube screen. Prime the oil pump by filling the inlet opening with oil and rotating the pump shaft until oil emerges from the outlet opening. Install the oil pump and inlet tube assembly.
9. Position the oil pan gaskets on the cylinder block. Position the oil pan front seal on the cylinder block front cover and interlock the seal with the gaskets. Position the oil pan rear seal on the rear main bearing cap and interlock the seal with the gaskets. Install the oil pan and related parts, following the procedure under Oil Pan Installation in this Part. Install the oil level dipstick.
10. Fill the crankcase. Start the engine and check for oil pressure. Operate the engine at fast idle and check for oil leaks.

PISTONS AND CONNECTING RODS

Removal

1. Drain the cooling system and the crankcase. Remove the intake manifold, cylinder heads, oil pan and oil pump, following the procedures in this section.
2. Remove any ridges and/or deposits from the upper end of the cylinder bores as follows.

Turn the crankshaft until the piston to be removed is at the bottom of its travel, then place a cloth on the piston head to collect the cuttings. Remove the cylinder ridge with a ridge cutter. Follow the instructions furnished by the tool manufacturers.

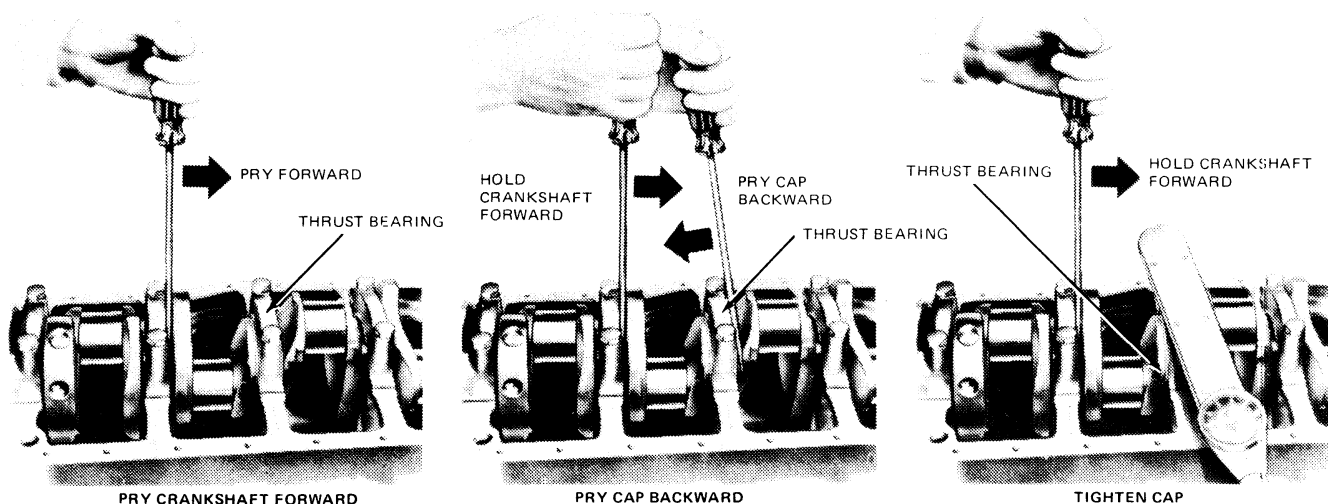


FIG. 39 Aligning Thrust Bearing

Never cut into the ring travel area in excess of 1/32 inch when removing ridges.

3. Make sure all connecting rod caps are marked so that they can be installed in their original positions.
4. Turn the crankshaft until the connecting rod being removed is down.
5. Remove the connecting rod nuts and cap.
6. Push the connecting rod and piston assembly out the top of the cylinder with the handle end of a hammer. **Avoid damage to the crankshaft journal or the cylinder wall when removing the piston and rod.**
7. Remove the bearing inserts from the connecting rod and caps.
8. Install the cap on the connecting rod from which it was removed.

Installation

1. If new piston rings are to be installed, remove the cylinder wall glaze. Follow the instructions of the tool manufacturer.
2. Oil the piston rings, pistons and cylinder walls with heavy engine oil. **Be sure to install the pistons in the same cylinders from which they were fitted.** The connecting rod and bearing caps are numbered from 1 to 4 in the right bank and from 5 to 8 in the left bank, beginning at the front of the engine. The numbers on the connecting rod and bearing cap must be on the same side when installed in the cylinder bore. If a connecting rod is ever transferred from one block or cylinder to another, new bearings should be fitted and the connecting rod should be numbered to correspond with the new cylinder number.

When installing the piston and connecting rod assembly, the largest chamfer at the bearing end of the rod should be positioned towards the crank pin thrust face of the crankshaft.

3. Make sure the ring gaps (oil ring spacer-A, oil ring-B, compression ring-C) are properly spaced around the circumference of the piston, (Fig. 40).

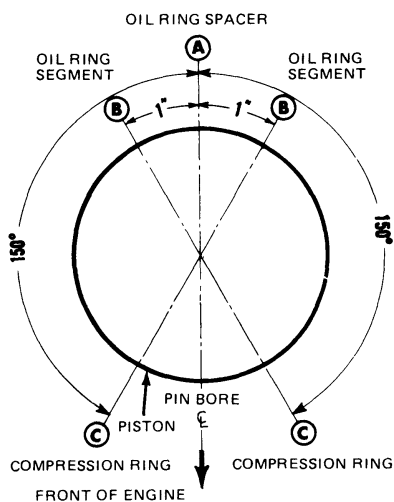


FIG. 40 Piston Ring Spacing

4. Install a piston ring compressor on the piston and push the piston in with a hammer handle until it is slightly below the top of the cylinder (Fig. 41). Be sure to guide the connecting rods to avoid damaging the crankshaft journals. Install the piston with the indentation notch in the piston head toward the front of the engine.

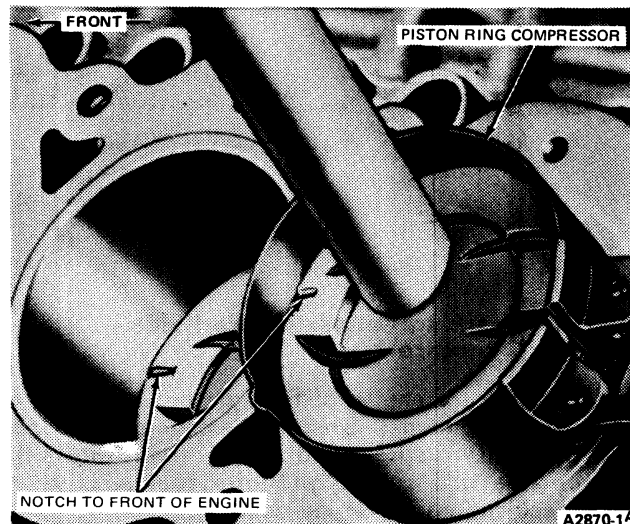


FIG. 41 Installing Piston

5. Check the clearance of each bearing, following the procedure under Fitting Main and Connecting Rod Bearings in Part 21-01.
6. After the bearings have been fitted, apply a light coat of engine oil to the journals and bearings.
7. Turn the crankshaft throw to the bottom of its stroke. Push the piston all the way down until the connecting rod bearing seats on the crankshaft journal.
8. Install the connecting rod cap. Tighten the nuts to specifications.
9. After the piston and connecting rod assemblies have been installed, check the side clearance between the connecting rods on each shaft journal (Fig. 42).
10. Disassemble, clean, and assemble the oil pump. Clean the oil pump inlet tube screen and the oil pan and block gasket surfaces.
11. Prime the oil pump by filling the inlet port with engine oil and rotating the pump shaft to distribute the oil within the housing. Install the oil pump and the oil pan, following the procedures under Oil Pan Installation in this section.
12. Install the cylinder heads, following the steps under Cylinder Head Installation.
13. Install the intake manifold, following the steps under Intake Manifold Installation.
14. Fill and bleed the cooling system. Fill the crankcase with the proper grade and quantity of engine oil.
15. Start the engine, then check and adjust the ignition timing. Connect the distributor vacuum hoses to the distributor.

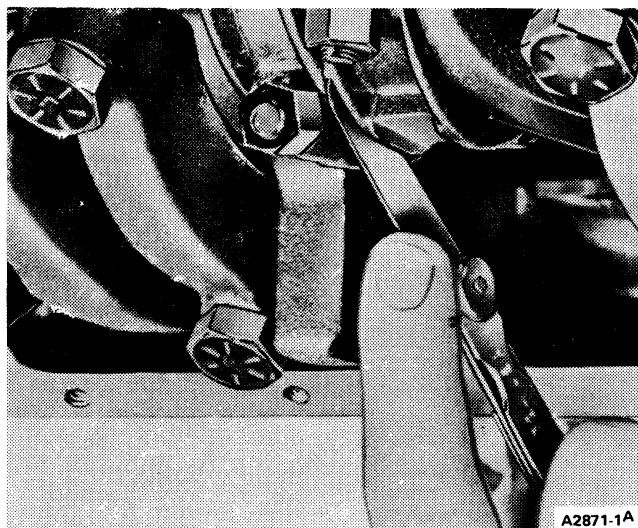


FIG. 42 Checking Connecting Rod Side Clearance

16. Operate the engine at fast idle and check for oil and coolant leaks. Operate the engine until engine temperatures have stabilized, then adjust the engine idle speed and idle fuel mixture to specifications on engine decal.
17. Install the air cleaner and intake duct assembly, including the crankcase ventilation hose.

CRANKSHAFT

The crankshaft and related parts are shown in (Fig. 43).

Removal

1. With the engine removed from the vehicle and placed in a work stand, disconnect the spark plug wires at the spark plugs and remove using Tool-T68P-6666-A or equivalent the wires and bracket assembly from the attaching stud on the valve rocker arm covers. Disconnect the coil to distributor high-tension lead at the coil. Remove the distributor cap and spark plug wires as an assembly. Remove the spark plugs to allow easy rotation of the crankshaft.
2. Remove the fuel pump and oil filter. Slide the water pump by-pass hose clamp toward the water pump. Remove the alternator and mounting brackets.
3. Remove the crankshaft pulley from the crankshaft vibration damper. Remove the capscrew and washer from the end of the crankshaft. Install the puller on the crankshaft vibration damper (Figs. 25 and 44) and remove the damper.
4. Remove the cylinder front cover and water pump as an assembly.
5. Check the timing chain deflection following procedures in Part 21-01, then remove the timing chain and sprockets by following steps under Cylinder Front Cover and Timing Chain Removal.
6. Invert the engine on the work stand. Remove the clutch pressure plate and disc (manual-shift transmission). Remove the flywheel and engine rear cover plate. Remove the oil pan and gasket. Remove the oil pump.
7. **Make sure all bearing caps (main and connecting rod) are marked so that they can be installed in their original locations.** Turn the crankshaft until the connecting rod from which the

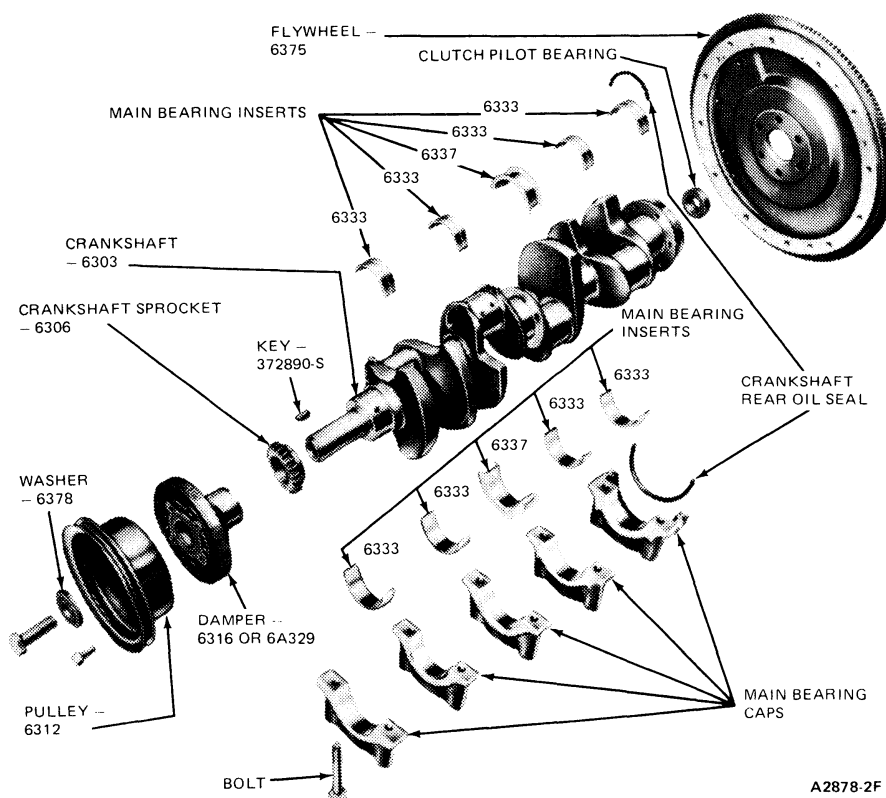


FIG. 43 Crankshaft and Related Parts

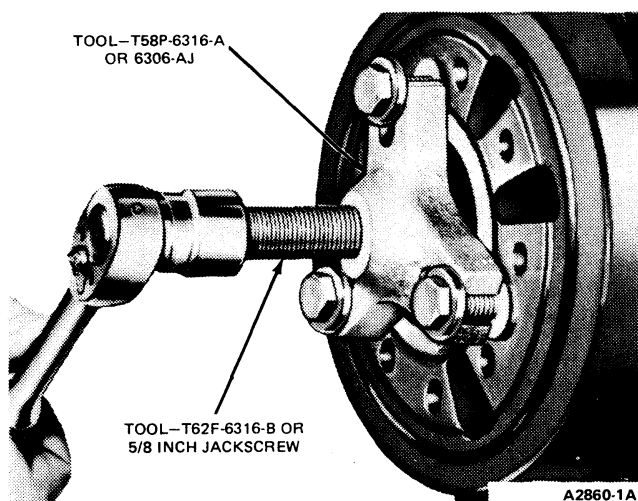


FIG. 44 Crankshaft Vibration Damper Removal—E-100—E-350

cap is being removed is down, and remove the bearing cap. Push the connecting rod and piston assembly up into the cylinder. Repeat this procedure until all the connecting rod bearing caps are removed.

8. Remove the main bearing caps.
9. Carefully lift the crankshaft out of the block so that the thrust bearing surfaces are not damaged. **Handle the crankshaft with care to avoid possible fracture or damage to the finished surfaces.**

To refinish journals, dress minor imperfections, etc., refer to Part 21-01.

Installation

1. Remove rear journal oil seal from the block and rear main bearing cap.
2. Remove the main bearing inserts from the block and bearing caps.
3. Remove the connecting rod bearing inserts from the connecting rods and caps.
4. If the crankshaft main bearing journals have been refinished to a definite undersize, install the correct undersize bearings. Be sure the bearing inserts and bearing bores are clean. Foreign material under the inserts will distort the bearing and cause a failure.
5. Place the upper main bearing inserts in position in bores with the tang fitting in the slot provided.
6. Install the lower main bearing inserts in the bearing caps.
7. Clean the rear journal oil seal groove and the mating surfaces of the block and rear main bearing cap with Ford Spot Remover (B7A-19521-A) or equivalent. Refer to Part 21-01 for special instructions in seal replacement. Remove the rear oil seal retainer pin from the rear main bearing cap seal groove. The pin is not used with the split, lip-type seal.
8. Dip the lip-type seal halves in clean engine oil. Install the seals in the bearing cap and block with the undercut side of the seal toward the FRONT of the engine as shown in Part 21-01.

9. Carefully lower the crankshaft into place. **Be careful not to damage the bearing surfaces.**
10. Check the clearance of each main bearing by following the procedure under Fitting Main and Connecting Rod Bearings in Part 21-01.
11. After the bearings have been fitted refer to Part 21-01 for special instructions in applying RTV sealer to the rear main bearing cap.
12. Apply heavy engine oil SE to the journals and bearings.
13. Install all the bearing caps, except the thrust bearing cap (No. 3 bearing). **Be sure that the main bearing caps are installed in their original locations.** Tighten the bearing cap bolts to specifications.
14. Install the thrust bearing cap with the bolts finger-tight.
15. Pry the crankshaft forward against the thrust surface of the upper half of the bearing.
16. Hold the crankshaft forward and pry the thrust bearing cap to the rear. This will align the thrust surfaces of both halves of the bearing.
17. Retain the forward pressure on the crankshaft. Tighten the cap bolts to specification.
18. Force the crankshaft toward the rear of the engine.
19. Check the crankshaft end play (refer to Part 21-01).
20. Install new bearing inserts in the connecting rods and caps. Check the clearance of each bearing, following the procedure under Fitting Main and Connecting Rod Bearings in Part 21-01.
21. After the connecting rod bearings have been fitted, apply a light coat of engine oil SE to the journals and bearings.
22. Turn the crankshaft throw to the bottom of its stroke. Push the piston all the way down until the rod bearing seats on the crankshaft journal.
23. Install the connecting rod cap. Tighten the nuts to specifications.
24. After the piston and connecting rod assemblies have been installed, check the side clearance between the connecting rods on each connecting rod crankshaft journal (Fig. 42) following Specifications listed at the end of this Part.
25. Install the timing chain and sprockets, cylinder front cover and crankshaft pulley and adapter, following steps under Cylinder Front Cover and Timing Chain Installation.
26. Coat the threads of the flywheel attaching bolts with oil-resistant sealer. Position the flywheel on the crankshaft flange. Install and tighten the bolts to specifications.

On a flywheel for manual-shift transmission, use Tool 6392-N or equivalent to locate the clutch disc. Install the pressure plate. Tighten the attaching bolts to Specifications.

27. Clean the oil pan, oil pump and oil pump screen. Prime the oil pump by filling the inlet port with engine oil and rotating the pump shaft to distribute oil within the housing. Install the oil pump and oil pan by following the procedures under Oil Pan and Oil Pump Installation in this Part.

28. Install the oil filter, fuel pump and connect the fuel lines. Install the alternator, shield and mounting bracket.
29. Install the spark plugs, distributor cap and spark plug wires. Connect the spark plug wires and high-tension lead.
30. Install the engine in the vehicle.

CAMSHAFT BEARINGS

Camshaft bearings are available prefinished to size for standard and 0.015 inch undersize journal diameters. The bearings are not interchangeable from one bore to another.

Removal

1. Remove the camshaft, flywheel and crankshaft, following the appropriate procedures in this Part. Push the pistons to the top of the cylinders.
2. Remove the camshaft rear bearing bore plug as detailed in Part 21-01. Remove the camshaft bearings (Fig. 45).
3. Select the proper size expanding collet and back-up nut and assemble on the expanding mandrel. With the expanding collet collapsed, install the collet assembly in the camshaft bearing, and tighten the back-up nut on the expanding mandrel until the collet fits the camshaft bearing.
4. Assemble the puller screw and extension (if necessary) as shown and install on the expanding mandrel. Wrap a cloth around the threads of the puller screw to protect the front bearing or journal. Tighten the pulling nut against the thrust bearing and pulling plate to remove the camshaft bearing. Be sure to hold a wrench on the end of the puller screw to prevent it from turning.
5. Repeat the procedure for each bearing. To remove the front bearing, install the puller screw from the rear of the cylinder block.

Installation

1. Position the new bearings at the bearing bores with the oil holes aligned and press them in place with the tool shown in (Fig. 45). Be sure to center the

pulling plate and puller screw to avoid damage to the bearing. Failure to use the correct expanding collet can cause severe bearing damage. Be sure the front bearing is installed the specified distance below the front face of the cylinder block (Fig. 46).

2. Install a new rear bearing bore plug.
3. Install the camshaft, crankshaft, flywheel and related parts, following the appropriate procedures, except do not check connecting rod and main bearing clearances as a part of Camshaft Bearing Replacement. Install the engine in the vehicle.

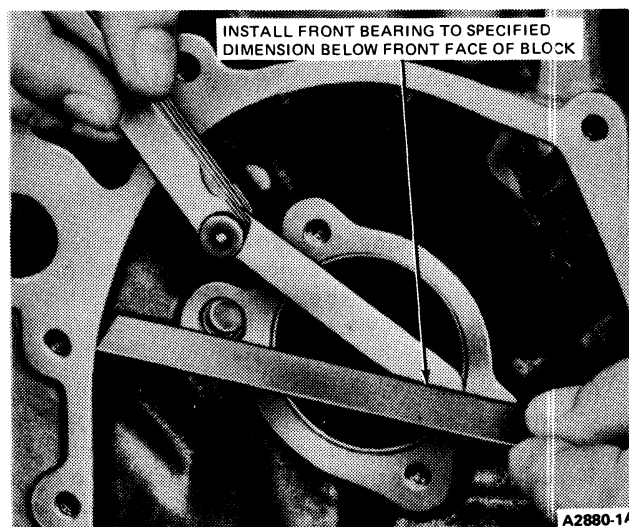


FIG. 46 Camshaft Front Bearing Replacement

OIL FILTER

The oil filter assembly is shown in Fig. 44.

Removal

1. Position a drip pan under the oil filter.
2. Unscrew the filter from the adapter fitting using an oil filter wrench and clean the adapter fitting.

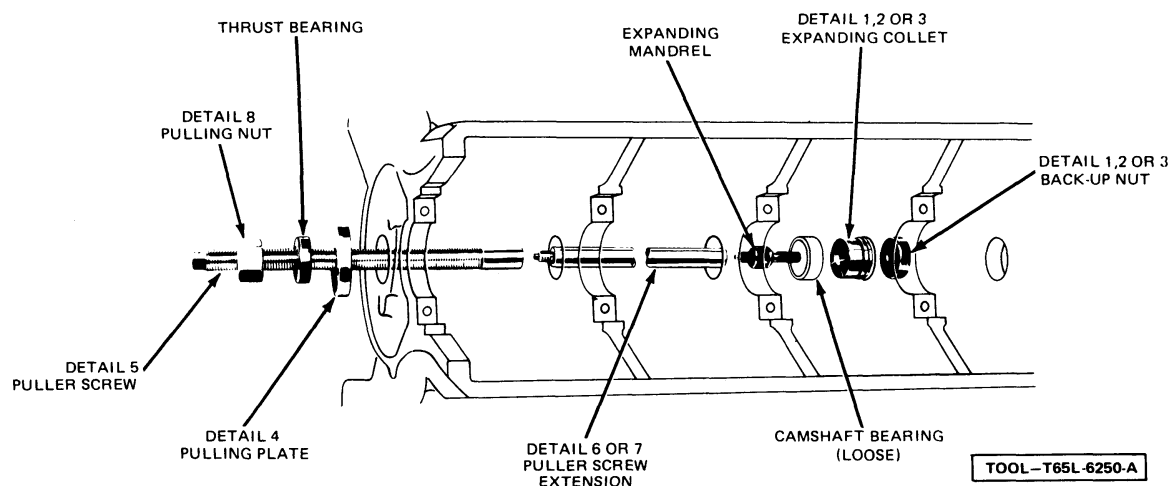


FIG. 45 Camshaft Bearing Replacement

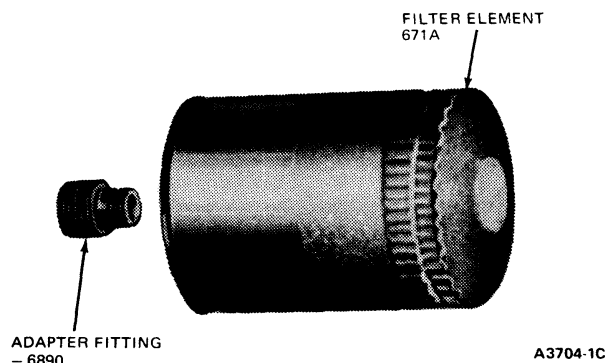


FIG. 47 Oil Filter Assembly

On E-100—E-250 equipped with power steering, be sure the wheels are fully to the right before removing the filter. Then unscrew the filter from the adapter fitting, turn it horizontal and let the excess oil drain off. Slide the oil filter towards the rear of the vehicle and remove as shown in Fig. 47. Some

effort may be required to slide the oil filter between the engine crossmember and power steering hoses.

Installation

1. Coat the gasket on a new filter with oil. Place the new filter in position on the adapter fitting.
On E-100—E-250 equipped with power steering, make sure that the wheels are turned fully to the right, then slide the oil filter forward between the crossmember and power steering hoses (Fig. 47) to position it on the adapter fitting.
2. Hand tighten the filter until the gasket makes contact and then advance it one-half turn.
3. Operate the engine at fast idle and check for oil leaks. If oil leaks are evident, perform the necessary repairs to correct the leakage. Remove the drip pan.
4. Check the oil level and fill the crankcase as necessary.

DISASSEMBLY AND ASSEMBLY

When installing nuts or bolts that must be tightened (refer to specifications), oil the threads with lightweight engine oil. **Do not oil threads that require oil-resistant or water-resistant sealer.**

Refer to Part 21-01 for the cleaning and inspection procedures.

TAPPET

The internal parts of each hydraulic tappet assembly are matched sets. Do not intermix the parts. Keep the assemblies intact until they are to be cleaned.

Tappets should always be tested after assembly. Refer to the test procedures in Part 21-01.

Disassembly

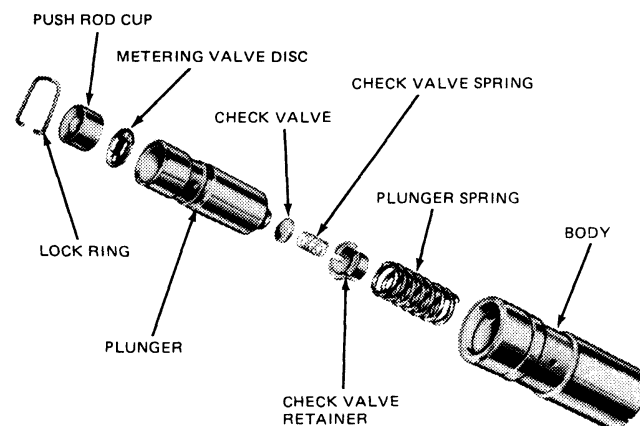
Disassemble and assemble each tappet separately. Keep the tappet assemblies in proper sequence so that they can be installed in their original bores.

1. Grasp the lock ring with needle nose pliers to release it from the groove. It may be necessary to depress the plunger to fully release the lock ring.
2. Remove the push rod cup, metering valve (disc), plunger and spring.
3. Carefully remove the plunger spring, the check valve retainer and, the check valve spring and valve from the plunger.

Assembly

Tappet assembly is shown in Fig. 45.

1. Place the plunger upside down on a clean work bench.
2. Place the check valve (disc or ball check) in position over the oil hole on the bottom of the plunger. Set the check valve spring on top of the check valve (disc or ball check).



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FIG. 48 Tappet Assembly

3. Position the check valve retainer over the check valve and spring and push the retainer down into place on the plunger.
4. Place the plunger spring, and then the plunger (open end up) into the tappet body.
5. Position the metering valve (disc) in the plunger, and then place the push rod cup in the plunger.
6. Depress the plunger, and position the closed end of the lock ring in the groove of the tappet body. With the plunger still depressed, position the open ends of the lock ring in the groove. Release the plunger, and then depress it again to fully seat the lock ring.
7. Use the tappet leakdown tester (Part 21-01) to fill the tappets with test fluid.

CYLINDER HEADS

Disassembly

1. Remove the exhaust manifolds and the spark plugs.

2. Clean the carbon out of the cylinder head combustion chambers before removing the valves.
3. Compress the valve spring (Fig. 49). Remove the spring retainer locks and release the spring.

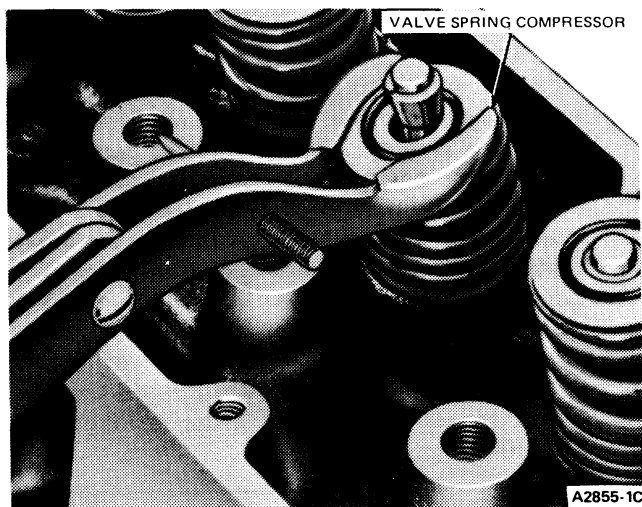


FIG. 49 Compressing Valve Spring On Bench

4. Remove the sleeve, spring retainer, spring, stem seal (intake valve) or cap (exhaust valve) and valve. Discard the valve stem seals. Identify all valve parts.
5. Clean, inspect and repair the cylinder head as required, or transfer all usable parts to a new cylinder head.

Assembly

1. Install each valve in the port from which it was removed or to which it was fitted. Install a new stem seal on the valve, use a 5/8 inch deep wall socket and a light hammer or mallet to seat the seal on the valve stem.
2. Install the valve spring over the valve, and then install the spring retainer and sleeve. Compress the spring (Fig. 49) and install the retainer locks (Fig. 50).
3. Measure the assembled height of the valve spring from the surface of the cylinder head spring pad to the underside of the spring retainer with dividers (Fig. 51). Check the dividers against a scale. If the assembled height is greater than specifications, install the necessary 0.030 inch thick spacer(s) between the cylinder head spring pad and the valve spring to bring the assembled height to the recommended height.

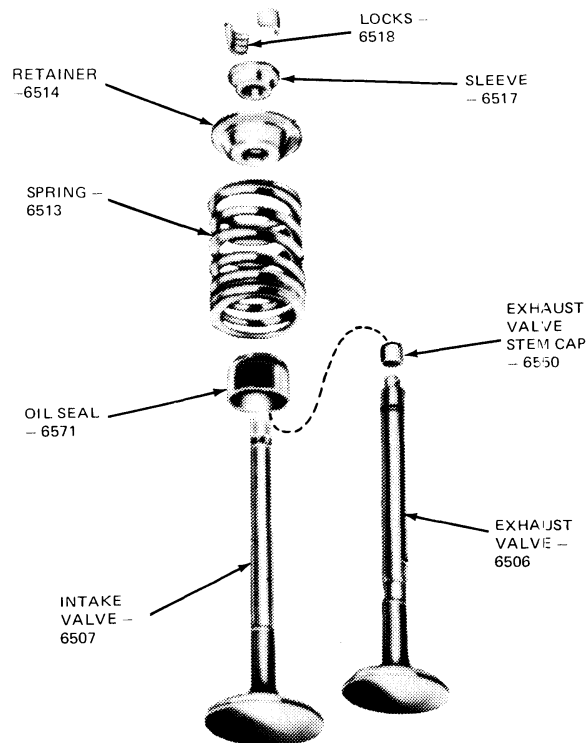
Do not install the spacers unless necessary. Use of spacers in excess of recommendations will result in overstressing the valve springs and overloading the camshaft lobes which could lead to spring breakage and worn camshaft lobes.

4. Install the exhaust manifolds and the spark plugs.

OIL PUMP

Disassembly

1. Remove the oil inlet tube from the oil pump and remove the gaskets.



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FIG. 50 Valve Assembly

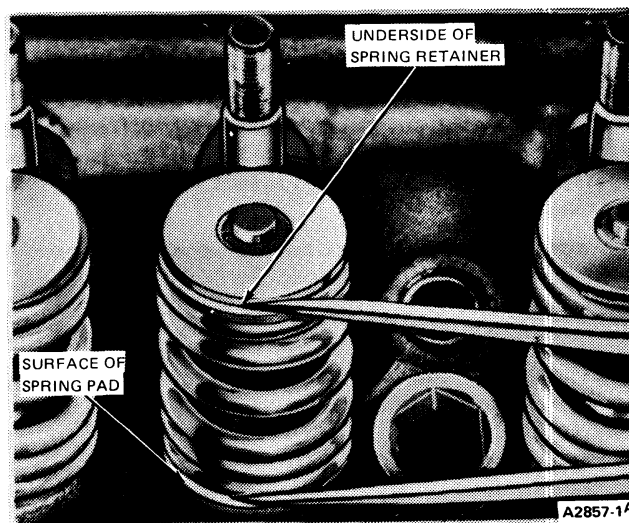


FIG. 51 Checking Valve Spring Assembled Height

2. Remove the cover attaching bolts, then remove the cover. Remove the inner rotor and shaft assembly; then, remove the outer race.
3. Drill a small hole and insert a self-threading sheet metal screw of the proper diameter into the oil pressure relief valve chamber cap and pull the cap out of the chamber. Remove the spring and plunger.

Assembly

The oil pump assembly is shown in Fig. 52.

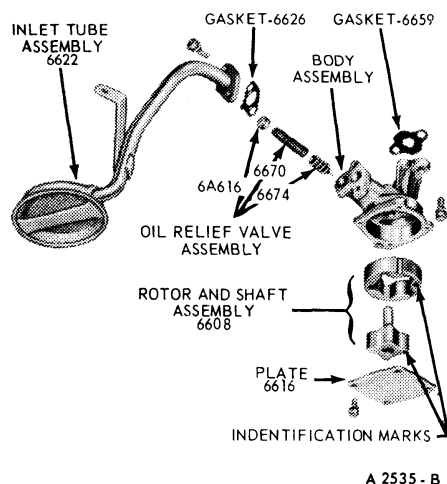
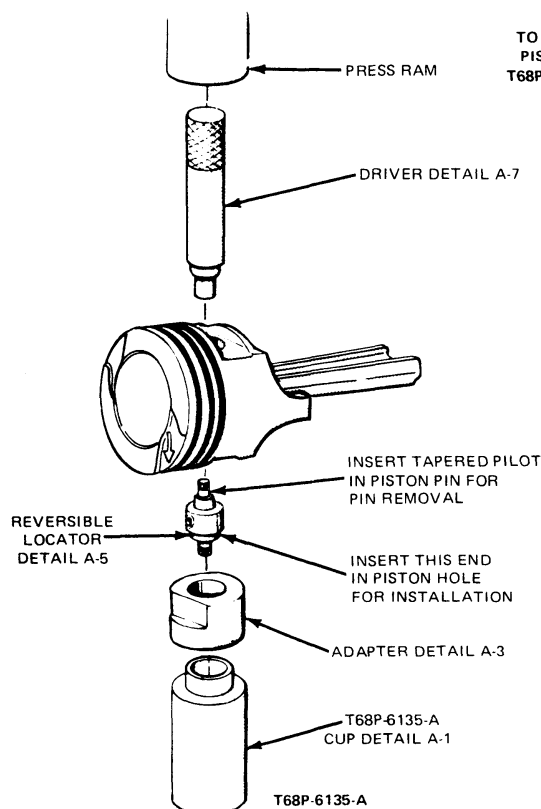


FIG. 52 Oil Pump—Disassembled

1. Clean, inspect and oil all parts thoroughly.
2. Install the oil pressure relief valve plunger, spring and a new cap.
3. Install the outer race and the inner rotor and shaft assembly. **Be sure the dimple (identification mark) on the outer race is facing the same side as the identification mark on the rotor. The inner rotor and shaft and the outer race are serviced as an assembly. One part should not be replaced without replacing the other.** Install the cover and tighten the cover attaching bolts to specifications



4. Install the attaching bolts.

PISTONS AND CONNECTING RODS

Disassembly

1. Remove the bearing inserts from the connecting rod and cap.
2. Mark the pistons to assure assembly with the same rod and installation in the same cylinders from which they were removed.
3. Using an Arbor press and the tool shown in Fig. 53, press the piston pin from the piston and connecting rod. Remove the piston rings.

Assembly

The piston, connecting rod and related parts are shown in Fig. 54. Check the fit of a new piston in the cylinder bore before assembling the piston and piston pin to the connecting rod.

The piston pin bore of a connecting rod and the diameter of the piston pin must be within specifications listed at the end of this Part.

1. Apply a light coat of engine oil SE to all parts. **Assemble the piston to the connecting rod with the indentation in the piston positioned as shown in Fig. 55.**

On replacement connecting rods, install the large-chamfered side of the connecting rod bearing bore towards the crankshaft check; facing towards front of engine on the right bank rods, and facing towards rear of engine on left bank rods.

2. Start the piston pin in the piston and connecting rod (this may require a very light tap with a mallet).

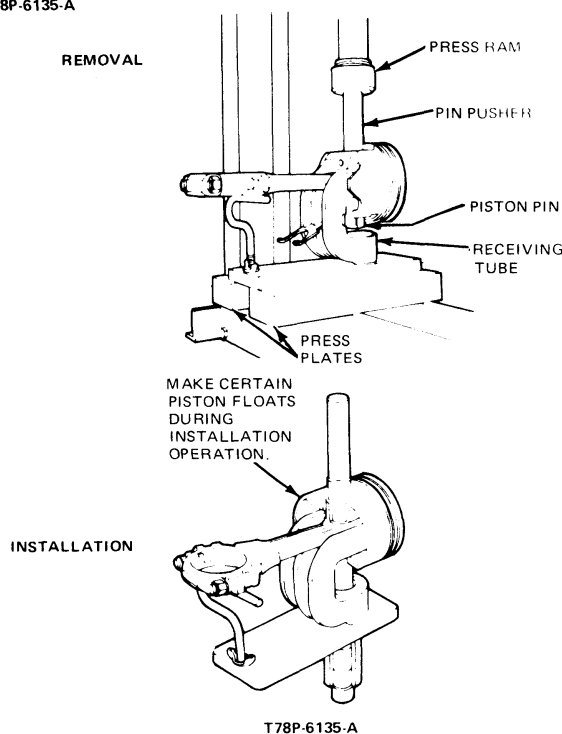


FIG. 53 Removing or Installing Piston Pin

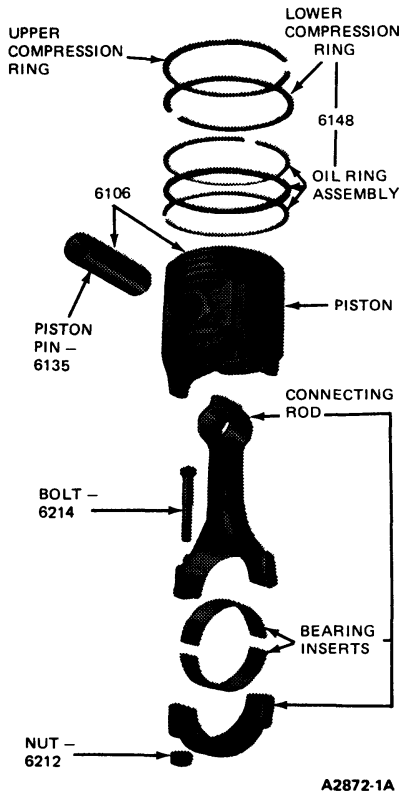


FIG. 54 Piston, Connecting Rod and Related Parts

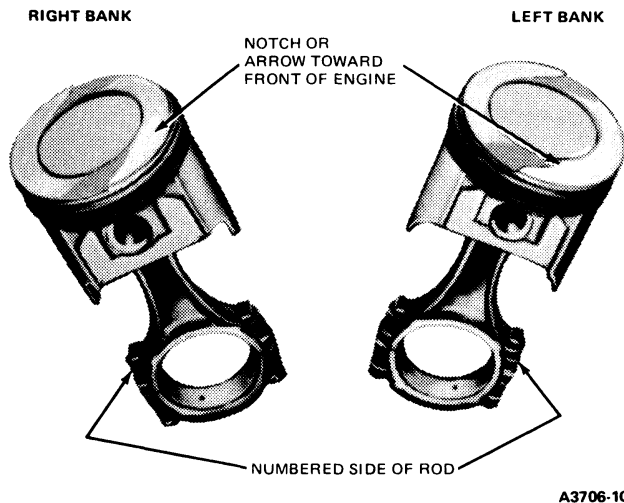


FIG. 55 Correct Piston and Rod Positions

Using an Arbor Press, press the piston pin through the piston and connecting rod until the pin is centered in the piston (Fig. 53).

3. Check the end gap of all piston rings (Part 21-01). It must be within specifications listed at the end of this Part. Follow the instructions contained on the piston ring package and install the piston rings.

4. Check the ring side clearance (refer to Specification at the end of this Part) of the compression rings with a feeler gauge inserted between the ring and its lower land (Part 21-01). The gauge should slide freely around the entire ring circumference without binding. Any wear that occurs will form a step at the inner portion of the lower land. **If the lower lands have high steps, the piston should be replaced.**
5. Be sure the bearing inserts and the bearing bore in the connecting rod and cap are clean. Foreign material under the inserts will distort the bearing and cause a failure. Install the bearing inserts in the connecting rod and cap with the tangs fitting in the slots provided.

CYLINDER ASSEMBLY—(6009)

Disassembly

1. Mount the old engine in a work stand and remove all parts not furnished with the new cylinder assembly; following the procedures given in the Removal and Installation section of this Part.
2. Remove the old cylinder assembly from the work stand.

Assembly

1. Clean the gasket and seal surfaces of all serviceable parts and assemblies.
2. Position the new cylinder assembly in a work stand.
3. Transfer all serviceable parts removed from the old cylinder assembly, following the procedures given in the Removal and Installation section of this Part.
4. Check all assembly clearances following Specifications listed at the end of this Part, and correct as necessary.

CYLINDER BLOCK—(6010)

Before replacing a cylinder block, determine if it is repairable. If so, make the necessary repairs, following the procedures given in Part 21-01.

Disassembly

1. Completely disassemble the old engine, following the procedures given in the Removal and Installation section of this Part.
2. Remember to ridge-ream the cylinder bores before removing piston assemblies.

Assembly

1. Clean the gasket and seal surfaces of all serviceable parts and assemblies.
2. Position the new cylinder block in a work stand.
3. Transfer all serviceable parts removed from the old cylinder block, following the procedures given in the Removal and Installation section of this Part.
4. Check all assembly clearances following Specifications listed at the end of this Part, and correct as necessary.

SPECIFICATIONS

GENERAL SPECIFICATIONS

Engine	Bore and Stroke	Firing Order	Oil Pressure Hot @ 2000 RPM		Engine Type and Number of Cylinders	Belt Tension — (lbs) ①
			kPa	(PSI)		
5.0L (302 CID) V-8	4.00 x 3.00	15426378	275-413	(40-60)	O.H.V. V-8	—
5.8L (351 CID) W-V-8	4.00 x 3.50	13726548	275-448	(40-65)	O.H.V. V-8	—

①

Belt Size	Newly Installed ④		Used Less Than 10 Min.		Used Over 10 Min.	
	N·m	(lbs)	N·m	(lbs)	N·m	(lbs)
All except 1/4"	534-711	(120-160)	400-711	(90-160 ⑤)	334-533	(75-120 ⑥)
1/4" Only	223-355	(50-80)	178-355	(40-80 ⑦)	178-266	(40-60 ⑧)

④ Tension measured immediately after belt is installed and before it is stretched or seats in pulley grooves.

⑤ If less than 90 lbs., readjust to 90 lbs., readjust to 90-120 lbs.

⑥ If less than 40 lbs., readjust to 40-60 lbs.

⑦ If less than 75 lbs., readjust to 90-120 lbs.

CYLINDER HEAD

Engine	Combustion Chamber Volume C.C. ②	Valve Guide Bore Diameter		Valve Seat Width ①		Valve Seat Runout TIR Maximum	Valve Arrangement Front to Rear	Gasket Surface Flatness ③	Rocker Arm Stud Bore Diameter Std.
		Intake	Exhaust	Intake	Exhaust				
5.0L (302 CID) V-8	67.5-70.5	.3433-	.3433-	.060-	.060-	.002	RT I-E-I-E-I-E-I-E LT E-I-E-I-E-I-E-I	.003 in any 6 in. .006 overall	.3685- .3695
5.8L (351 CID) W-V-8		.3443	.3443	.080	.080				

① Valve seat angle — 45°.

② Gasket surface finish — RMS 60-150.

③ Compression pressure (PSI) of the lowest cylinder must be at least 75½ of the highest to be within specification.

VALVE ROCKER ARM SHAFT, PUSH RODS AND TAPPETS

Engine	Rocker Arm Lift Ratio to 1	Push Rod Runout TIR Maximum	Valve Tappet or Lifter			Collapsed Tapped Gap (Clearance)	
			Standard Diameter	Clearance to Bore ①	Hydraulic Lifter Leakdown Rate ②	Allowable	Desired
5.0L (302 CID) V-8	1.61	.015	.8740-.8745	.0007-.0027	10 to 50 seconds for 1/16 travel	.071-.193	.096-.165
5.8L (351 CID) W-V-8	1.61	.015	.8740-.8745	.0007-.0027	10 to 50 seconds for 1/16 travel	.098-.198	.123-.173

① Service limit .005.

② Time required for plunger to leakdown .0625 in. under load of 50 lbs. using leakdown fluid in tappet.

VALVE SPRINGS

Engine	Valve Spring Compression Pressure (lbs) @ Specified Height		Valve Spring Free Length (Approximate)		Valve Spring Assembled Height		Valve Spring Out of Square Maximum
	Intake ①	Exhaust	Intake	Exhaust	Intake	Exhaust	
5.0L (302 CID) V-8	74-82 @ 1.78 196-212 @ 1.36	76-84 @ 1.60 190-210 @ 1.20	2.04	1.85	1-43/64—1-51/64	1-37/64—1-39/64	5/64 (.078)
5.8L (351 CID) W-V-8	74-82 @ 1.78 190-210 @ 1.36	76-84 @ 1.60 190-210 @ 1.20	2.04	1.85	1-49/64—1-51/64	1-37/64—1-39/64	5/64 (.078)

① Service limit — 10½ loss pressure.

VALVES

Engine	Valve Stem to Guide Clearance ①		Valve Head Diameter ②		Valve Face Runout Maximum
	Intake	Exhaust	Intake	Exhaust	
5.0L (302 CID) V-8 5.8L (351 CID) W-V-8	.0010-.0027	.0015-.0032	1.770-1.794	1.439-1.463	.002

① Service clearance — .0055.

② Valve face angle — 44°.

VALVES (Continued)

Engine	Valve Stem Diameter					
	Standard		.015 Oversize		.030 Oversize	
	Intake	Exhaust	Intake	Exhaust	Intake	Exhaust
5.0L (302 CID) V-8	.3416-.3423	.3411-.3418	.3566-.3573	.3561-.3568	.3716-.3723	.3711-.3718
5.8L (351 CID) W-V-8						

CAMSHAFT

Engine	Lobe Lift ①		Camshaft End Play		Camshaft Journal to Bearing Clearance ②
	Intake	Exhaust	End Play	Wear Limit	
5.0L (302 CID) V-8	.2375	.2470	.001-.007	.009	.001-.003
5.8L (351 CID) W-V-8	.2600	.2600	.001-.007	.009	.001-.003

① Maximum allowable lift loss — .005.

② Service limit — .006 maximum.

CAMSHAFT DRIVE

Engine	Camshaft Journal Diameter — Standard ①					Camshaft Bearing Inside Diameter					Camshaft Front Bearing Location ②	Timing Chain Deflection Inches Maximum
	No. 1	No. 2	No. 3	No. 4	No. 5	No. 1	No. 2	No. 3	No. 4	No. 5		
5.0L (302 CID) V-8	2.0805	2.0655	2.0505	2.0355	2.0205	2.0825	2.0675	2.0525	2.0375	2.0225	.005-.020	.500
5.8L (351 CID) W-V-8	2.0815	2.0665	2.0515	2.0365	2.0215	2.0835	2.0685	2.0535	2.0385	2.0235		

① Camshaft journal runout — .005 TIR maximum.

② Distance in inches that front edge of the bearing is installed below the front face of the cylinder block.

CYLINDER BLOCK

Engine	Cylinder Bore Diameter ①	Main Bearing Bore Diameter ②	Distributor Shaft Bearing Bore Diameter	Head Gasket Surface Flatness	Head Gasket Surface Finish	Tappet Bore Diameter
5.0L (302 CID) V-8	4.0004-4.0052	2.4412-2.4420	.4525-.4541	.003 in any 6 in. .006 overall	RMS 60-150	.8752-.8767
5.8L (351 CID) W-V-8	4.0000-4.0048	3.1922-3.1930	.5155-.5170	.003 in any 6 in. .006 overall	RMS 60-150	.8752-.8767

① Maximum out-of-round — .0015, Service limit — .005, Maximum taper service limit — .010, Cylinder bore surface finish — RMS 18-38, Bore tapes service limit — .010.

CRANKSHAFT AND FLYWHEEL

Engine	Main Bearing Journal Diameter ①	Main Bearing Journal Runout TIR Maximum ②	Main Bearing Thrust Face Runout TIR Maximum	Main Bearing Journal Taper Maximum Per Inch	Thrust Bearing Journal Length	Main and Rod Bearing Journal Finish RMS Maximum	Main Bearing Thrust Face Finish RMS Maximum
5.0L (302 CID) V-8	2.2482-2.2490	.002	.001	.0005	1.137-1.139	12	25 Front—20 Rear
5.8L (351 CID) W-V-8	2.9994-3.0002	.002	.001	.0005	1.137-1.139	12	25 Front—20 Rear

① Maximum out-of-round — .0006.

② Service limit — .005.

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CRANKSHAFT AND FLYWHEEL (Continued)

Engine Assembled	Connecting Rod Journal Diameter ①	Connecting Rod Journal Taper Per Inch Maximum	Crankshaft Free End Play ②
5.0L (302 CID) V-8	2.1228-2.1236	.0006	.004-.008
5.8L (351 CID) W V-8	2.3103-2.3111	.0006	.004-.008

① Maximum out-of-round — .0006.

② Service limit — .012.

CRANKSHAFT BEARINGS

Engine	Connecting Rod Bearing to Crankshaft Clearance Selective Fit			Main Bearing to Crankshaft Clearance Selective Fit		
	Desired	Allowable	Bearing Wall Thickness Std. ①	Desired	Allowable	Bearing Wall Thickness Std. ①
5.0L (302 CID) V-8	.0008-.0015	.0007-.0024	.0572-.0577	②	③	④
5.8L (351 CID) W V-8	.0008-.0015	.0008-.0025	.0572-.0577	.0008-.0015	.0008-.0026	.0957-.0960

① For .002 undersize add .001 to standard wall thickness.

② #1 Bearing — .0001-.0015. All others — .0005-.0015.

③ #1 Bearing — .0001-.0020. All others — .0005-.0024.

④ #1 Upper only .0961 — .0966. All others .0957-.0962.

CONNECTING ROD

Engine	Piston Pin Bore or Bushing I.D.	Rod Bearing Bore I.D. ①	Rod Length Center to Center	Connecting Rod Alignment Maximum Total Difference		Rod to Crankshaft Assembled Side Clearance ③
				Twist ②	Bend ②	
5.0L (302 CID) V-8	.9096-.9112	2.2390-2.2398	5.0885-5.0915	.024	.012	.010-.020
5.8L (351 CID) W V-8	.9096-.9112	2.4265-2.4273	5.9545-5.9575	.024	.012	.010-.020

① Connecting rod bearing bore maximum out-of-round — .0004.

② Pin bushing and crankshaft bore must be parallel and in same vertical plane within specified total difference when measured at the ends of an 8-inch long bar, 4 inches on each side of rod centerline.

③ Service limit — .023.

PISTON

Engine	Diameter ①			Piston to Bore Clearance Selective Fit	Piston Pin Bore Diameter	Ring Groove Width Compression		
	Coded Rod	Coded Blue	.003 Oversize			Top	Bottom	Oil
5.0L (302) V-8	3.9984-3.9990	3.996-4.000	4.0008-4.0014	.0018-.0026	.9123-.9126	.080-.081	.080-.081	.188-.189
5.8L (351 CID) W V-8	3.9978-3.9984	3.9990-3.9996	4.0002-4.0008	.0018-.0026	.9124-.9127	.080-.081	.080-.081	.188-.189

① Measured at the piston pin bore centerline at 90° to the pin.

PISTON PIN

Engine	Length	Diameter			To Piston Pin Bore Clearance ①	To Connecting Rod Bushings Clearance
		Standard	.001 Oversize	.002 Oversize		
5.0L (302 CID) V-8	3.010-3.040	.9119-.9124	.9130-.9133	.9140-.9143	.0002-.0004	Interference Fit
5.8L (351 CID) W V-8	3.010-3.040	.9119-.9124	.9130-.9133	.9140-.9143	.0003-.0005	Interference Fit

① Selective fit.

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PISTON RINGS

Engine	Ring Width Compression		Side Clearance Compression ①			Ring Gap Compression		
	Top	Bottom	Top	Bottom	Oil	Top	Bottom	Oil ②
5.0L (302 CID) V-8 5.8L (351 CID) W V-8	.0770-.0780	.0770-.0780	.0019-.0036	.002-.004	Snug	.010-.020	.010-.020	.010-.035

① Service limit — .002 maximum increase in clearance.

② Steel rail.

OIL PUMP AND OIL CAPACITY

Engine	Relief Valve Spring Pressure Lbs. @ Specified Length	Driveshaft to Housing Clearance	Relief Valve to Housing Clearance	Rotor Assembly End Clearance	Outer Race to Housing Clearance	Engine Oil Capacity Qts. — U.S. ①
5.0L (302 CID) V-8	10.6-12.2 @ 1.74	.0015-.0030	.0015-.0030	.004 Maximum	.001-.013	5
5.8L (351 CID) V-8	18.2-20.2 @ 2.49	.0015-.0030	.0015-.0030	.004 Maximum	.001-.003	5

① Add 1 qt. when replacing filter.

FUEL PUMP — MECHANICAL

Engine	Static Pressure (PSI) ①	Volume Flow — Minimum ① ②	Eccentric Total Lift — Inches
5.0L (302 CID) V-8 5.8L (351 CID) W V-8	6.0-8.0	1 pint in 20 seconds	.690-.710

① On the engine with temperatures normalized and at normal curb idle speed, in neutral.

② The inside diameter of the smallest passage in the test flow circuit must not be less than .220.

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TORQUE LIMITS — 5.0L (302 CID) V-8 — 5.8L (351 CID) W-V-8

NOTE: All values in N•m (ft-lbs), unless otherwise noted. Oil threads with engine oil unless the threads require oil or water-resistant sealer. The standard torque limits listed below are applicable for all functions not listed in the special torque chart.

1/4-20	5/16-18	5/16-24	3/8-16	3/8-24	7/16-14	7/16-20	1/2-13	9/16-18
8-12 (6-9)	17-24 (12-18)	19-27 (14-20)	30-43 (22-32)	37-51 (27-38)	61-77 (45-57)	55-81 (40-60)	75-81 (55-60)	116-162 (85-120)

Pipe Threads

1/8-27	1/4-18	3/8-18	1/2-14
7-11 (5-8)	17-24 (12-18)	30-44 (22-33)	34-47 (25-35)

Item	Torque	
	N•m	(ft-lbs)
Camshaft Sprocket — Gear to Camshaft	55-61	(40-45)
Camshaft Thrust Plate to Cylinder Block	13-16	(9-12)
Connecting Rod Nut — 5.0L (302 CID) V-8	26-32	(19-24)
5.8L (351 CID) W-V-8	55-61	(40-45)
Cylinder Front Cover	17-24	(12-18)
Cylinder Head Bolts	① ②	
Damper to Crankshaft	95-122	(70-90)
EGR Valve to Carburetor Spacer or Intake Manifold	17-24	(12-18)
Fuel Pump to Cylinder Block or Front Cover	26-36	(19-27)
Flywheel to Crankshaft	102-115	(75-85)
Main Bearing Cap Bolts — 5.0L (302 CID) V-8	82-94	(60-70)
— 5.8L (351 CID) W-V-8	129-142	(95-105)
Manifold to Cylinder Head — Intake	32-33	(23-25)
Manifold to Cylinder Head — Exhaust	25-32	(18-24)
Intake Manifold Vacuum Fittings — Aluminum	8-13	(6-10)
— Cast Iron	32-37	(23-28)
Intake Manifold Pipe Fittings — Aluminum	17-24	(12-18)
— Cast Iron	32-37	(23-28)
Oil Inlet Tube to Main Bearing Cap	30-43	(22-32)
Thermactor Pump Bracket to Cylinder Block	44-67	(30-45)
Carburetor Mounting Stud	7-13	(5-10)
Distributor Clamp Down	24-32	(17-25)
Oil Filter Insert to Cylinder Block/Adaptor	28-40	(20-30)
Oil Filter to Adaptor or Cylinder Block	1/2 turn after gasket contacts sealing surface — oiled gasket	
Oil Inlet Tube Pump	14-20	(10-15)
Oil Pan Drain Plug	21-33	(15-25)
Oil Pan to Cylinder Block	13-14	(9-11)
Oil Pump to Cylinder Block	30-43	(22-32)
Pulley to Damper Bolt	48-67	(35-50)
Rocker Arm Stud/Bolt to Cylinder Head	25-33	(18-25)
Spark Plug to Cylinder Head	14-20	(10-15)
Valve Rocker Arm Cover	4-6	(3-5)
Water Outlet Housing	13-16	(9-12)
Water Pump to Block/Front Cover	17-24	(12-18)
Alternator Bracket to Cylinder Block — Bolt	17-24	(12-18)
Alternator Adjusting Arm to Alternator Bolt	33-60	(24-40)
Thermactor Pump Pivot Bolt	30-43	(22-32)
Thermactor Pump Adjusting Arm to Pump	30-43	(22-32)
Thermactor Pump Pulley to Pump Hub	17-24	(150-220 in-lbs)
Fuel Filter to Carburetor	10-11	(80-100 in-lbs)
Carburetor Attaching Nuts	17-20	(12-15)

① 5.0L (302 CID) V-8 — Torque in steps: first to 75-88 N•m (55-65) then to 88-97 N•m (65-72).

② 5.8L (351 CID) W-V-8 — Torque in steps: first to 115 N•m (85) then to 129 N•m (95), final to 143-151 N•m (105-112).

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Description	Ford Tool No.	Former No.	APPLICATION IN ENGINE SIZE			
			4.9L (300 CID) I-6	5.0L (302 CID) V-8 5.8L (351 CID) W-V-8	7.5L (460 CID) V-8	5.8L (351 CID) M-V-8 6.6L (400 CID) V-8
Engine Lifting Bracket — Use with T53L-300-A	T58P-6000-A	6000-BD			X	
Engine Lifting Hook	T60K-6000-A		X			
Engine Lifting Cradle	T65E-6000-B		X			
Engine Support Bar	T65E-6000-J		X			
Adapter Mount — To fit K.R. Wilson 1009 or Manzel 6001-TES	T64L-6001-B or T64L-6001-C	T52T-6005-CJD T52T-6005-KJD TOOL-6001-FBA	X	X	X	
Cylinder Front Cover Pilot	T61K-6019-A	4222-M, 6059-D	X			
	T61P-6019-B	6059-F	X	X	X	
Valve Guide Reamer Kit	T58P-6085-B	6085-H			X	
	T60K-6085-B	6085-AE	X			
Piston Pin Remover and Replacer Press	T65L-6135-C	T60K-6135-B	X		X	
Piston Pin Remover	T52P-6135-DAD				X	
Camshaft Bearing Remover or Replacer	T56-6250-A					
Camshaft Bearing Remover and Replacer Adapters	T65L-6250-A	T52L-6261-CEE	X	X	X	X
Cylinder Head Core Plug, Cylinder Block Core Plug and Camshaft Bearing Bore Plug Replacer	T52L-6266-BGD	6266-B	X			
Crankshaft Sprocket and Crankshaft Damper Replacer	T52L-6306-AEE	3355-D 6306-AC		X		X
Crankshaft Damper Replacer	T64T-6306-A		X	X	X	
Crankshaft Damper Replacer — Use w/T64T-6306-A	T65L-6306-A		X			
Crankshaft Gear Installer	T52L-6306-AEE			X		X
Crankshaft Damper Remover Adapter Screw Use with T58P-6316-B	T64T-6316-A		X			
Crankshaft Damper Remover	T58P-6316-B		X		X	
Upper Main Bearing Insert Remover and Replacer	T00L-6331	6331	X	X		X
Upper Main Bearing Insert Remover and Replacer	T00L-6331-E	6331-E			X	
Hydraulic Tappet Clip Replacer	T00L-6500-C	6500-C	X		X	
Impact Hammer	T50T-100-A		X	X	X	
Impact Slide Hammer (Replaces OTC-927)	T59L-100-B		X	X	X	X
Puller Attachment — Use with T50T-100-A or T59L-100-B	T58L-101-A	OTC-927	X	X	X	X
Handle Adapter	T53L-200-A		X	X	X	
Engine Lifting Sling	T53L-300-A	6000-BA	X	X	X	X
Gear Puller ○	T00L-OTC-943		X			
Differential Backlash and Runout Gauge, with Universal Bracket Dial Indicator and Bracket — Includes Indicator TOOL-6565	T00L-4201-C	4201-C	X	X	X	

○ Used on 4.9L (300 CID) I-6 engines only

CA4937-2A

Description	Ford Tool No.	Former No.	APPLICATION IN ENGINE SIZE			
			4.9L (300 CID) I-6	5.0L (302 CID) V-8 5.8L (351 CID) W-V-8	7.5L (460 CID) V-8	5.8L (351 CID) M-V-8 6.6L (400 CID) V-8
Hydraulic Tappet Leakdown Tester	T00L-6500-E	6500-E	X	X	X	
Hydraulic Tappet Plunger Remover and Replacer	T00L-6500-F	6500-F	X	X	X	
Hydraulic Lifter Remover	T52T-6500-DJD	6500-D			X	
Valve Stem Clearance Checking Tool	T65T-6505-H	6505-E		X		
Valve Stem Clearance Checking Tool	T00L-6505-G	6505-G	X			
Valve Spring and Rocker Arm Compressor	T00L-6513-J	6513-J			X	
Valve and Clutch Spring Tester	T00L-6513-DD	6513-DD	X	X	X	
Air Adapter and Hose-Valve Holdup	T00L-6513-ABA	6513-AB	X	X	X	
Rocker Arm Stud Kit	T62F-6A527-B	6527-A, B	X	X		
Cam Lift and Push Rod Stroke Dial Indicator — 1 inch range (Part of T00L-4201-C)	T00L-6565	6565	X	X	X	
Valve Spring Compressor	T62F-6565-A	6513-HH	X	X		
Cup Shaped Adapter to T00L-6565	T00L-6565-AB	6565-AB	X	X	X	
Cylinder Front Cover Oil Seal Installer	T68P-6700-A				X	
Cylinder Block Front Cover Oil Seal Replacer	T58P-6700-B	6700-B	X	X		
Adapter — Use with T53L-200-A	T58P-6700-A				X	
Crankshaft Rear Oil Seal Forming Tool	T58P-6701-A	6701-C			X	
Crankshaft Rear Oil Seal Forming Tool	T60K-6701-A	6701-E				
Crankshaft Rear Oil Seal Forming Tool	T65L-6701-A		X			
Clutch Pilot Bearing Replacer	T65L-7600-A		X			
Clutch Pilot Bearing Replacer	T00L-7600-H	7600-H		X		
Rocker Arm Stud Installer	T65P-6A527-A		X			
Rocker Arm Stud Installer	T69P-6049-D		X			
Crankshaft Gear Remover	T52L-6316-FEE or T52L-6316-EE		X			
Valve Compressor	T00L-6513-AC		X			
Piston Pin Remover	T68P-6135-A		X	X		X
Engine Lifting Bracket	T62F-6085-A			X		X
Spark Plug Wire Remover	T68P-6666-A			X	X	X
Hydraulic Valve Lifter Remover	T70L-6500-A			X		
Cylinder Head Holding Fixture	T62F-6085-A			X		X
Crankshaft Vibration Damper Remover	T58P-6316-A			X		
Crankshaft Vibration Damper Remover	T62F-6316-B			X		
Clutch Disc Locating Tool	T00L-6392-N			X		
Valve Compressor	T71P-6513-A			X	X	X
Valve Spring Compressor	T70P-6049-A				X	X
Hydraulic Valve Lifter Remover	T70P-14151			X		X
Front Cover Seal Remover	T70P-6B070-B					X
Front Cover Seal Installer	T70P-6B070-A					X
Camshaft Rear Bearing Bore Plug Installer	T70P-6011-A					X
Valve Stem Burr Remover	T70P-6505-A					X
Engine Lifting Sling	T75T-6000-A				X	

CA4938-2A

5.8L (351 CID)-M V-8 and 6.6L (400 CID) V-8 Engines

PART 21-22

APPLIES TO ALL MODELS

SUBJECT	PAGE	SUBJECT	PAGE
ADJUSTMENTS		REMOVAL AND INSTALLATION (Cont'd.)	
Valve Clearance — Hydraulic		Cylinder Heads	21-22-15
Valve Tappets	21-22-6	Engine Assembly	21-22-7
DESCRIPTION		Engine Front Support Insulators	21-22-8
Crankcase Ventilation System	21-22-5	Engine Rear Support Insulators	21-22-9
Engine	21-22-1	Exhaust Manifold	21-22-15
Exhaust Emission Control System	21-22-5	Flywheel	21-22-21
DISASSEMBLY AND ASSEMBLY		Front Oil Seal	21-22-19
Cylinder Assembly — 6009	21-22-33	Intake Manifold	21-22-13
Cylinder Block — 6010	21-22-33	Main Bearing	21-22-23
Cylinder Head	21-22-30	Oil Filter	21-22-30
Oil Pump	21-22-32	Oil Pan	21-22-21
Piston and Connecting Rod	21-22-32	Oil Pump	21-22-22
Valve Tappet	21-22-31	Pistons and Connecting Rods	21-22-25
REMOVAL AND INSTALLATION		Valve Tappet	21-22-14
Camshaft	21-22-20	Valve Rocker Arm Cover	
Camshaft Bearings	21-22-28	and Rocker Arm	21-22-11
Camshaft Rear Bearing Bore Plug	21-22-21	Valve Spring, Retainer	
Clutch Pilot Bearings	21-22-28	and Stem Seal	21-22-12
Connecting Rod Bearings	21-22-25	Water Pump	21-22-17
Crankcase Ventilation System	21-22-11	SPECIFICATIONS	21-22-34
Crankshaft	21-22-26		
Crankshaft Rear Oil Seal	21-22-23		
Cylinder Front Cover Plate			
and Timing Chain	21-22-17		

DESCRIPTION

ENGINE

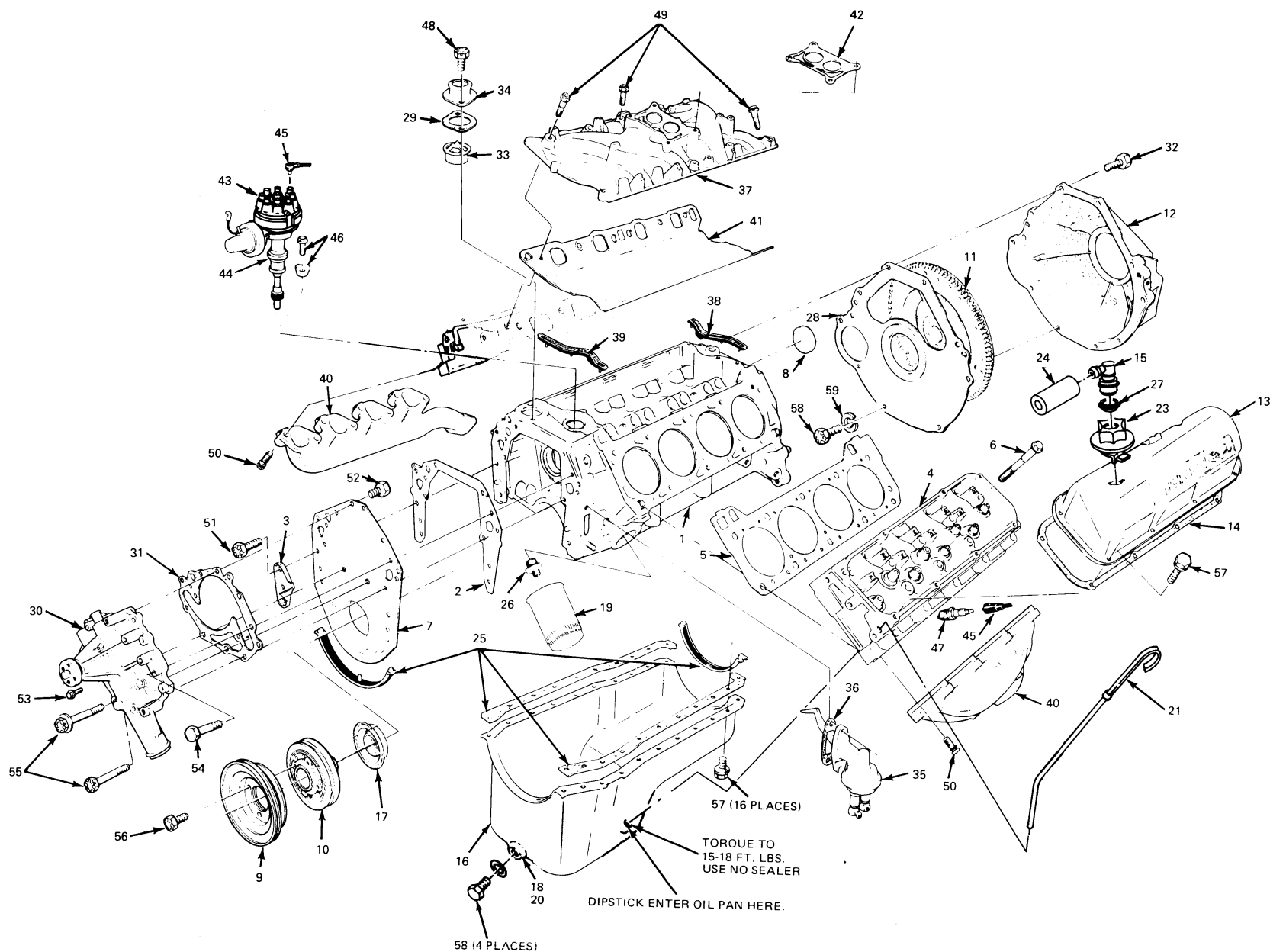
The 5.8L (351 CID) M-V-8 and 6.6L (400 CID) V-8 engines have the same basic design and structure. The cylinder block is thin wall, special high grade cast iron. The crankshaft has five main bearings and is precision cast nodular iron. The pistons are autothermic aluminum alloy, tin plated rockerarms are bolt mounted and the tappets are hydraulic.

With the exception of the crankshaft damper the differences between the two engines are internal. The 5.8L (351 CID) M-V-8 has shorter stroke utilizing a revised crankshaft and a piston with an increased

compression height. The camshaft is revised to provide proper valve timing. Refer to the chart at the end of this part for complete specifications.

The 5.8L (351 CID) M-V-8 engine is standard for the F350 4x4. The 5.8L (351 CID) M-V8 is optional on the F250—E350. The 6.6L (400 CID) V-8 is optional on the F150, F150 4x4, E-150, and Bronco.

The illustrations shown in Figs. 1 and 2 will serve as a reference for the procedures outlined in this part. The part descriptions and basic part numbers shown in the illustration keys correspond with the Ford Master Parts Catalog.



A4947-2A

FIG. 1 External Exploded View—5.8L (351 CID) M-V-8 and 6.6L (400 CID) V-8 Engines

REF. NO.	BASIC PART NO.	DESCRIPTION	REF. NO.	BASIC PART NO.	DESCRIPTION	REF. NO.	BASIC PART NO.	DESCRIPTION
1	6010	Block Assy. (Internal parts not included)	29	8255	Gasket — Water Outlet Connection	57	373071-S	Bolt — Washer Head — 1/4-20 x 5/8"
2	6020	Gasket — Cylinder Front Cover Plate	30	8501	Pump Assy. — Water	58	20346-S	Bolt — 5/16-18 x 3/4"
3	6023	Pointer — Timing	31	8507	Gasket — Water Pump Housing	59	34806-S	Washer — Lock — 5/16 x 19/32 x 5/64"
4	6049	Head — Cylinder	32	376275-S	Bolt — 7/16-14 x 2-9/16"			
5	6051	Gasket — Cylinder Head	33	8575	Thermostat — Water			
6	6065	Bolt — Cylinder Head	34	8592	Connection — Water Outlet			
7	6B070	Plate — Cylinder Front Cover	35	9350	Pump Assy. — Fuel			
8	6266	Plug — Camshaft Rear Bearing	36	9417	Gasket — Fuel Pump Mounting			
9	6312	Pulley Assy. — Crankshaft	37	9424	Manifold — Intake			
10	6316	Damper Assy. — Engine Crankshaft	38	9A424	Seal — Intake Manifold to Cylinder Block (rear)			
11	6375	Flywheel Assy.	39	9A425	Seal — Intake Manifold to Cylinder Block (front)			
12	6392	Housing Assy. — Flywheel	40	9430	Manifold — Exhaust			
13	6582	Cover Assy. — Valve Rocker Arm	41	9441	Valley Baffle — Intake Manifold to Cylinder Head			
14	6584	Gasket — Valve Rocker Arm Cover	42	9447	Gasket — Carburetor			
15	6A666	Elbow & Valve Assy. — Positive Crankcase	43	12106	Cap — Distributor			
16	6675	Pan Assy. — Oil	44	12127	Distributor Assy.			
17	6700	Seal — Cylinder Front Cover Oil	45	12259	Wire Set — Spark Plug			
18	6730	Plug — Oil Pan Drain	46	12270	Clamp — Distributor			
19	6731	Element Assy. — Oil Filter	47	12405	Spark Plug Assy.			
20	6734	Gasket — Oil Pan Drain Plug	48	57633-S	Screw and Lockwasher — 5/16-18 x 3/4"			
21	6750	Indicator — Oil Level	49	56126-S	Bolt Hex Washer Head — 5/16-18 x 2"			
22	6754	Tube Assy. — Oil Level Indicator	50	20522-S	Bolt — Washer Head — 3/8-16 x 2"			
23	6766	Cap Assy. — Oil Filler	51	56121-S	Bolt — 5/16-18 x 7/8"			
24	6767	Hose — Crankcase Ventilation	52	382127-S	Screw — Self-Tapping — 5/16-18 x 1-1/4"			
25	6781	Gasket Set — Oil Pan	53	383965-S	Screw — Self-Tapping — 5/16-18 x 2-7/8"			
26	6890	Insert — Oil Filter Mounting Bolt	54	373564-S	Bolt — Washer Head — 5/16-18 x 1-7/8"			
27	6A892	Retainer — Crankcase Ventilation Grommet	55	383963-S	Bolt — Washer Head — 5/16-18 x 2-7/8"			
28	7007	Plate Assy. — Engine Rear	56	42998-S	Bolt — 3/8-16 x 1"			

A4948-2A

FIG. 1 Key for External Exploded View

A4949-2A

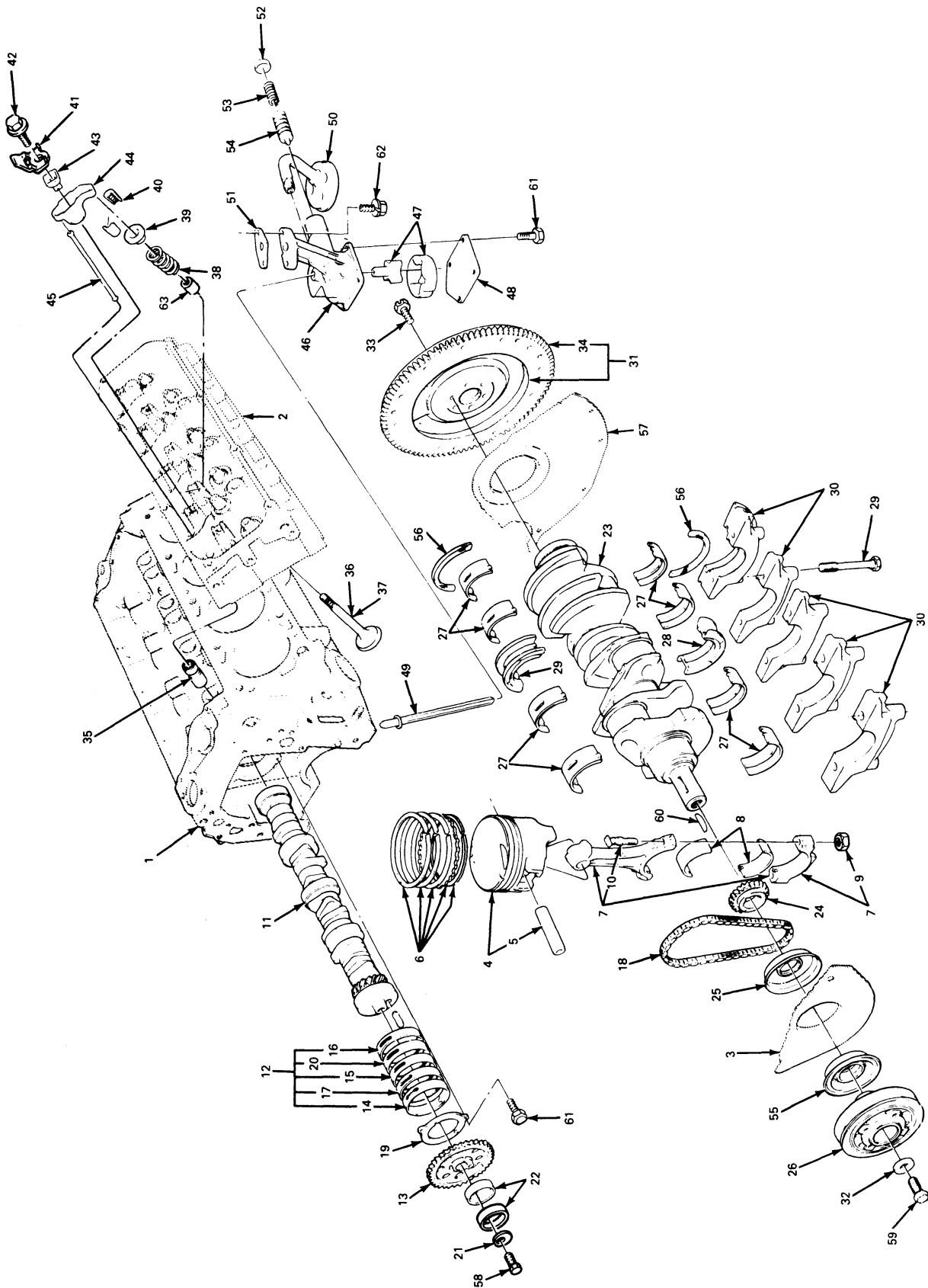


FIG. 2 Internal Exploded View—5.8L (351 CID) M-V-8 and 6.6L (400 CID) V-8 Engines

REF. NO.	BASIC PART NO.	DESCRIPTION	REF. NO.	BASIC PART NO.	DESCRIPTION	REF. NO.	BASIC PART NO.	DESCRIPTION
1	6010	Block Assy.	36	6505	Valve — Exhaust			
2	6049	Head — Cylinder	37	6507	Valve — Intake			
3	6B070	Plate — Cylinder Front	38	6513	Spring — Valve			
4	6108	Piston Assy.	39	6514	Retainer — Valve Spring			
5	6135	Pin — Piston	40	6518	Key — Valve Spring Retainer			
6	6148	Ring Set — Piston	41	6524	Baffle — Valve Push Rod Valley			
7	6200	Rod Assy. — Connecting	42	6A527	Bolt — Valve Rocker Arm Support			
8	6211	Bearing — Connecting Rod						
9	6212	Nut — Connecting Rod	43	6A528	Seat — Valve Rocker Arm Fulcrum			
10	6214	Bolt — Connecting Rod						
11	6250	Camshaft	44	6564	Arm — Valve Rocker			
12	6251	Bearing Kit — Camshaft — Standard	45	6565	Rod — Valve Push			
			46	6600	Pump Assy. — Oil			
13	6256	Sprocket — Camshaft	47	6608	Rotor and Shaft Assy. — Oil Pump Drive			
14	6261	Bearing — Camshaft Front						
15	6262	Bearing — Camshaft Center	48	6616	Plate — Oil Pump Body			
16	6263	Bearing — Camshaft Rear	49	6A618	Shaft Assy. — Oil Pump Intermediate			
17	6267	Bearing — Camshaft Front Intermediate	50	6622	Screen Tube and Cover Assy. — Oil Pump			
18	6268	Chain — Timing						
19	6269	Plate — Camshaft Thrust	51	6659	Gasket — Oil Pump Mounting			
20	6270	Bearing — Camshaft Rear Intermediate	52	6666	Plug — Oil Pump Relief Valve			
			53	6670	Spring — Oil Pump Relief Valve			
21	6287	Washer — Camshaft Sprocket	54	6674	Plunger — Oil Pump Relief Valve			
22	6287	Two Piece Fuel Pump Eccentric	55	6700	Seal — Cylinder Front			
23	6303	Crankshaft Assy.	56	6701	Packing — Crankshaft Rear			
24	6306	Sprocket — Crankshaft	57	7007	Plate — Engine Rear			
25	6310	Slinger — Crankshaft Oil	58	43002-S	Bolt — Slotted Head — 3/8-16 x 1-1/2"			
26	6316	Damper Assy. — Crankshaft						
27	6333	Bearing — Crankshaft Main (except center)	59	377850-S	Bolt — 3/4-16 x 1-25/32"			
			60	372854-S	Key — Woodruff — 1-3/4 x 7/32 x 3/16"			
28	6337	Bearing — Crankshaft (center)						
29	6345	Bolt — Crankshaft Main Bearing Cap	61	42911-S	Bolt — 1/4-20 x 5/8"			
			62	359266-S	Bolt — 3/8-16 x 1-1/4"			
30	*	Main Bearing Cap — Supplied in 6010 Block Assy.	63	6571	Oil Seal — Valve Stem			
31	6375	Flywheel Assy.						
32	6378	Washer — Crankshaft Pulley Retaining						
33	6379	Bolt — Flywheel to Crankshaft						
34	6384	Gear — Flywheel Ring						
35	6500	Tappet Assy. — Hydraulic						

A4950-2A

FIG. 2 Key for Internal Exploded View

ADJUSTMENTS

VALVE CLEARANCE—HYDRAULIC VALVE TAPPETS

The valve arrangement on the left bank is E-I-E-I-E-I-E-I and on the right bank is I-E-I-E-I-E-I-E.

A 0.060 inch shorter push rod or a 0.060 inch longer push rod are available for service to provide a means of compensating for dimensional changes in the valve mechanism. Refer to the Master Parts List for the pertinent part number.

Valve stem to valve rocker arm clearance should be within the specifications listed at the end of this part with the hydraulic tappet completely collapsed.

Repeated valve reconditioning operations (valve and/or valve seat refacing) will decrease the clearance to the point that if not compensated for, the hydraulic valve tappet will cease to function and the valve will be held closed.

To determine whether a shorter or a longer push rod is necessary, make the following check:

1. Disconnect the brown lead (I terminal) and the red and blue lead (S terminal) at the starter relay.

Install an auxiliary starter switch between the battery and S terminals of the Starter relay. **Crank the engine with the ignition switch OFF until the No. 1 piston is on TDC on the compression stroke.**

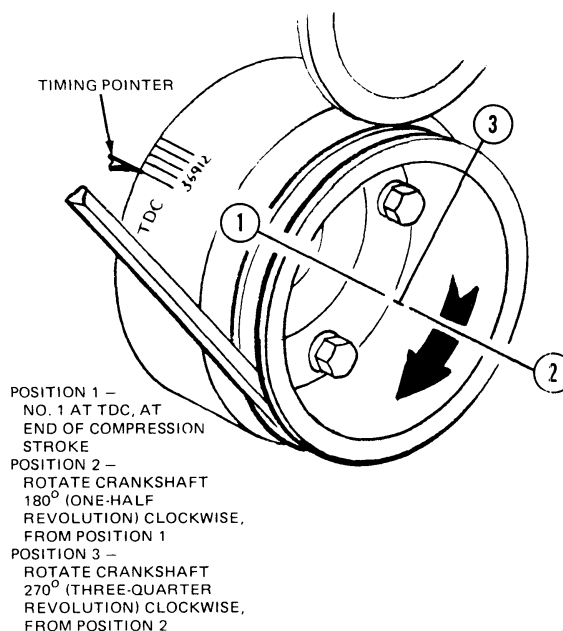
2. With the crankshaft in the positions designated in Steps 3, 4 and 5, position the hydraulic tappet compressor tool on the rocker arm. Slowly apply pressure to bleed down the hydraulic tappet until the plunger is completely bottomed (Fig. 3). Hold the tappet in this position and check the available

clearance between the rocker arm and the valve stem tip with a feeler gauge.

If the clearance is less than specification, install an undersize push rod. If the clearance is greater than specification, install an oversize push rod.

3. With the No. 1 piston on TDC at the end of the compression stroke, POSITION 1 in Fig. 4, check the following valves:

WITH NO. 1 AT TDC, AT END OF COMPRESSION STROKE, MAKE A CHALK MARK AT POINTS 2 AND 3 APPROXIMATELY 90 DEGREES APART.



A3234-1E

FIG. 4 Position of Crankshaft for Checking Valve Clearance and Installing Rocker Arms

No. 1 Intake No. 1 Exhaust

No. 4 Intake No. 3 Exhaust

No. 8 Intake No. 7 Exhaust

4. After these valves have been checked, rotate the crankshaft to POSITION 2 in Fig. 4, and check the following valves:

No. 3 Intake No. 2 Exhaust

No. 7 Intake No. 6 Exhaust

5. After these valves have been checked, rotate the crankshaft to POSITION 3 in Fig. 4 and check the following valves:

No. 2 Intake No. 4 Exhaust

No. 5 Intake No. 5 Exhaust

No. 6 Intake No. 8 Exhaust

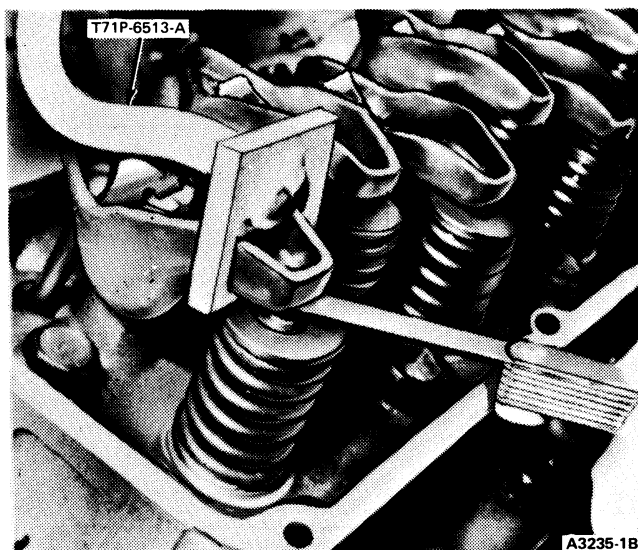


FIG. 3 Checking Valve Clearance

REMOVAL AND INSTALLATION

When installing nuts or bolts that must be tightened (refer to torque specifications at the end of this part), oil the threads with light weight engine oil. **Do not oil threads that require oil-resistant or water-resistant sealer.**

Refer to Part 21-01 for Cleaning, Inspection and Test procedures.

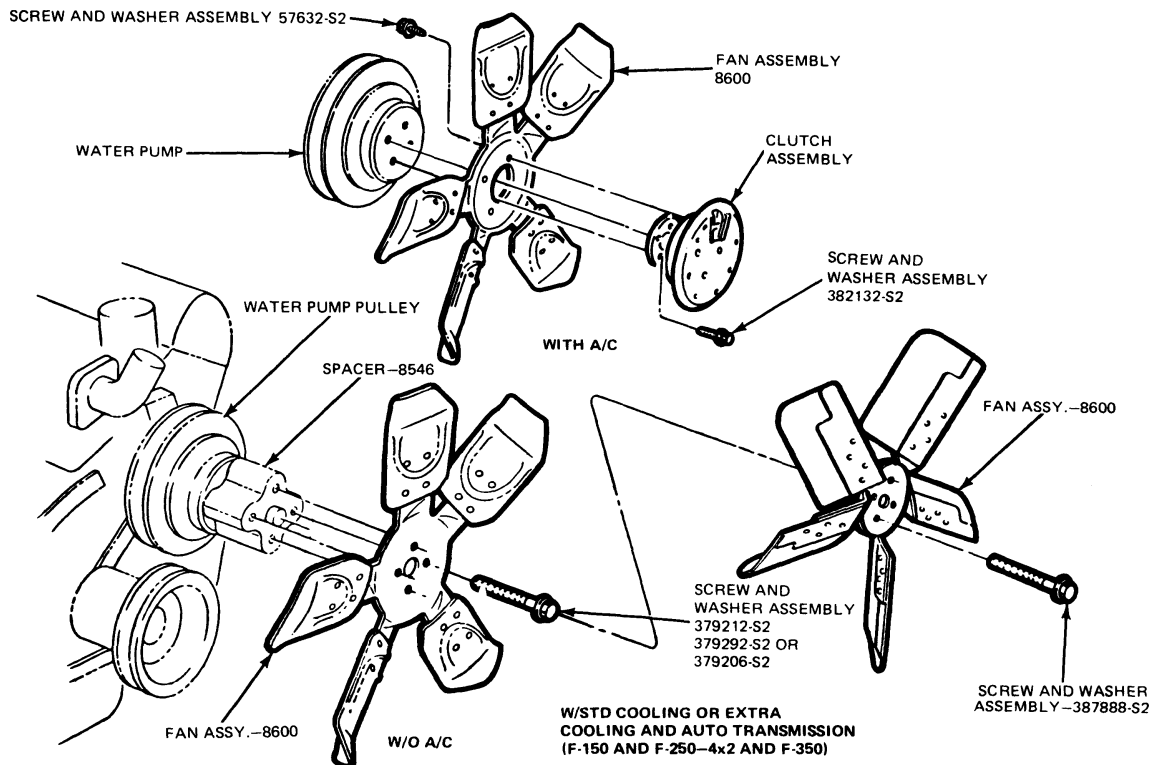
ENGINE ASSEMBLY

The engine removal and installation procedures are for the engine only without the transmission attached.

Removal

1. Drain the cooling system (refer to Part 27-02, General Cooling System Service) and the crankcase.
2. Disconnect the battery and alternator ground cables from the cylinder block.
3. Remove the air cleaner and intake duct assembly, including the crankcase ventilation hose and carbon canister hose.

4. Disconnect the radiator lower and upper hose at the radiator. If equipped with an automatic transmission, disconnect the transmission oil cooler lines.
5. Remove the fan shroud and position it over the fan. Remove the radiator (refer to Part 27-04, Radiators). Remove the fan shroud, fan spacer, belts and pulley (Figs. 5 and 6).
6. Disconnect the wires at the alternator. Loosen bolts and allow the alternator to swing down and out of the way.
7. Disconnect the oil pressure sending unit wire from the sending unit, and the flexible fuel line at the fuel tank line. Plug the fuel tank line.
8. Disconnect the accelerator cable from the carburetor. Disconnect speed control cable, if so equipped. Disconnect the transmission kickdown rod and remove the retracting spring if so equipped.
9. Disconnect the heater hoses from the water pump and intake manifold. Disconnect the water temperature sending unit wire from the sending unit. Remove air conditioner compressor and bracketry and swing to the side, if so equipped.



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FIG. 5 Engine Fan Assembly—F-150—F-350 And Bronco

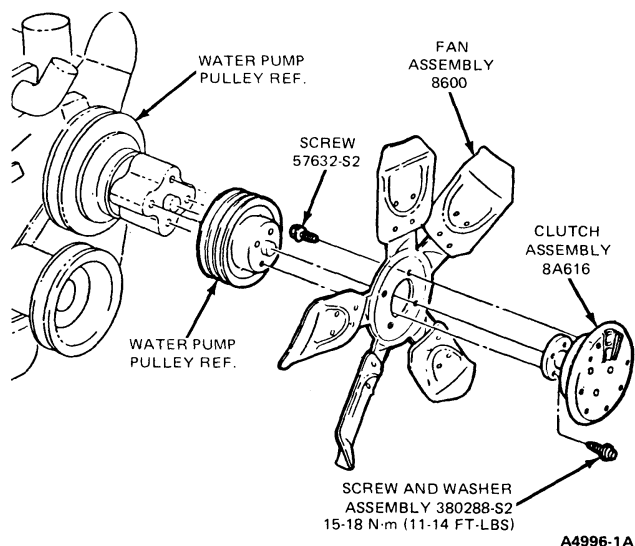


FIG. 6 Engine Fan Assembly—E-150—E-350

10. Remove the flywheel housing-to-engine upper bolts.
11. Disconnect the primary wire from the ignition coil. Remove the wire harness from the left rocker arm cover and position the wires out of the way. Disconnect the ground strap from the cylinder block.

12. Raise the front of the vehicle. Disconnect the starter cable from the starter. Remove the starter (refer to Group 28).
13. Disconnect the muffler inlet pipes from the exhaust manifolds. Disconnect the engine support insulators from the brackets on the frame underbody.

On a vehicle with automatic transmission, remove the converter inspection plate. Remove the torque converter-to-flywheel attaching bolts.

Remove the remaining flywheel housing-to-engine bolts.

14. Lower the vehicle, and then support the transmission. Install the engine lifting eyes on the front of the left cylinder head, and install the engine right lifting bracket at the rear of the right cylinder head. Then attach the engine lifting sling (Fig. 7).
15. Raise the engine slightly and carefully pull it from the transmission. Carefully lift the engine out of the engine compartment so that the rear cover plate is not bent or other components damaged. Install the engine on a workstand.

Installation

1. Attach the engine lifting brackets and sling (Fig. 7). Remove the engine from the workstand.
2. Lower the engine carefully into the engine compartment. Make sure the dowels in the block are through the rear cover plate, then engage the holes in the flywheel housing.

On a vehicle with manual transmission, start the transmission main drive shaft into the clutch disc. It may be necessary to adjust the position of the transmission in relation to the engine if the input shaft will not enter the clutch disc. **If the engine hangs up after the shaft enters, turn the**

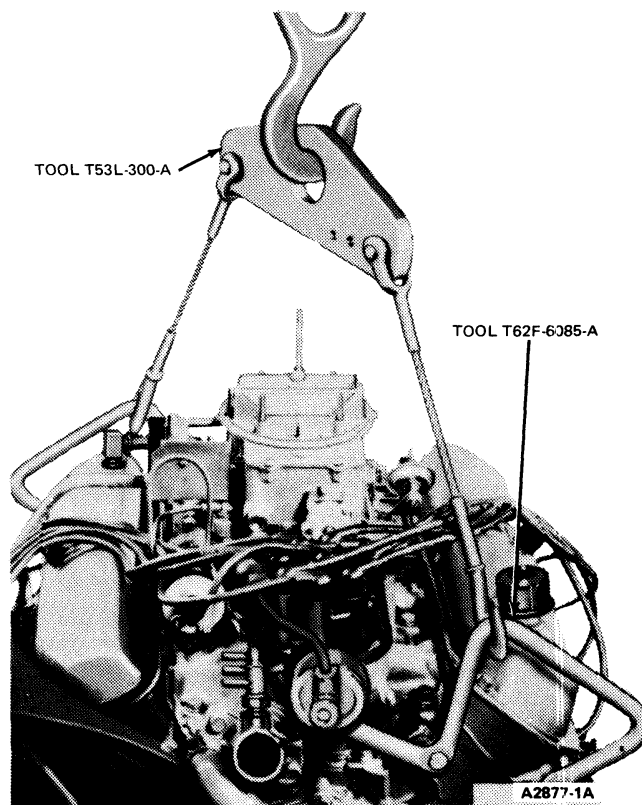


FIG. 7 Typical Engine Lifting Brackets and Sling

crankshaft slowly (transmission in gear) until the shaft splines mesh with the clutch disc splines.

3. Install the flywheel housing upper bolts.
4. Install the engine support insulator-to-bracket washers and attaching nuts. Disconnect the engine lifting sling and remove the lifting eyes.
5. Raise the front of the vehicle. Connect both exhaust manifolds to the muffler inlet pipes. Tighten the nuts to specifications listed in Part 26-01, General Exhaust System Service.
6. Position and install the starter and the starter cable (refer to Group 28).

Install the remaining flywheel housing-to-engine bolts.

On a vehicle with automatic transmission, install the converter-to-flywheel attaching bolts. Install the converter inspection plate.

7. Remove the support from the transmission and lower the vehicle.
8. Connect the wiring harness to the left valve rocker arm cover and connect the coil wire.
9. Connect the water temperature sending unit wire.
10. Connect the bellcrank to the intake manifold. Connect the transmission kickdown rod and install the retracting spring. Connect the accelerator cable. Connect the speed control cable, if so equipped.
11. Remove the plug from the fuel tank line and connect the fuel line and the oil pressure sending unit wire.
12. Install the pulley, belt, spacer and fan (Figs. 5 and 6). Position the fan shroud over the fan. Position

and install air conditioning compressor and bracketry, if so equipped.

13. Position the alternator and install the alternator bolts. Connect the alternator and the battery ground cables. Adjust the belt tension to specifications listed at the end of this Part.
14. Install the radiator (refer to Part 27-04, Radiators). Connect the radiator upper and lower hoses. Connect the transmission oil cooler lines if so equipped. Install the fan shroud.
15. Connect the heater hose at the water pump. Fill and bleed the cooling system (refer to Part 27-02, General Cooling System Service). Fill the crankcase with the proper grade and quantity of oil.
16. Operate the engine at fast idle and check all gaskets and hose connections for leaks.
17. Install the air cleaner and intake duct assembly including the crankcase ventilation hose and carbon canister hose.

ENGINE FRONT SUPPORT INSULATORS

The front supports (Figs. 8 and 9) are located on each side of the cylinder block. The procedures given apply to either a right or left installation.

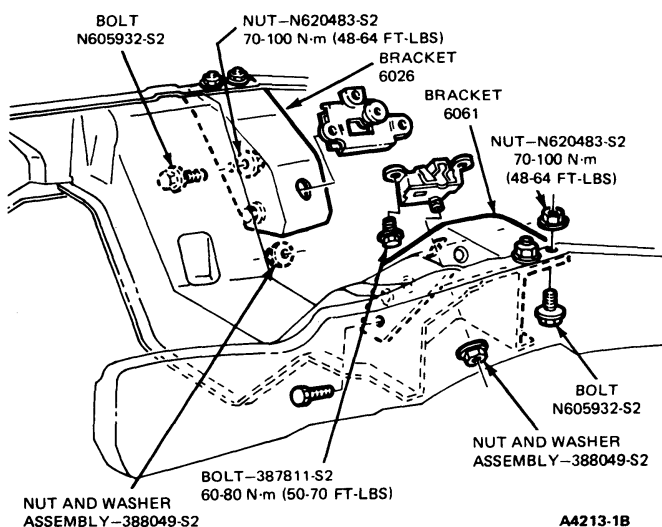


FIG. 8 Front Supports and Insulators—F-100—F-350 and Bronco

F-150—F-350 AND BRONCO

Removal

1. Remove the bolts attaching the fan shroud to the radiator and position the shroud over the fan.
2. Remove the nut and washer attaching the support insulator to the chassis bracket (Fig. 8).
3. Raise the engine.
4. Remove the bolts and lock washers attaching the support insulator to the cylinder block and remove the insulator.

Installation

1. Position the support insulator to the cylinder block and install the attaching bolts and lockwashers loosely (Fig. 8).

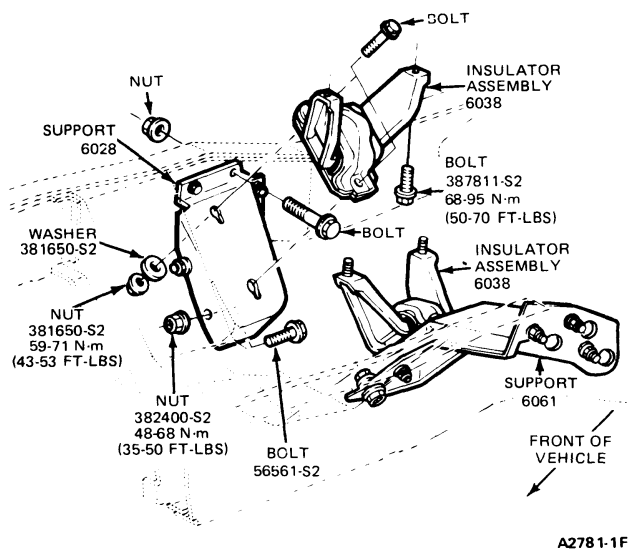


FIG. 9 Front Supports and Insulators—E-150—E-350

2. Carefully lower the engine, guiding the support insulator stud into the support bracket. Tighten the insulator-to-engine bolts to specifications.
3. Install the insulator-to-chassis bracket nut and washer. Tighten the nut to specifications.
4. Install the fan shroud attaching bolts.

E-150—E-350

Removal

1. Remove fan shroud bolts. Remove the insulator to support nuts.
2. Position transmission jack under engine assembly. Lift engine assembly and then remove starter.
3. Remove insulator to engine bolts and alternator splash shield. Remove the insulators (Fig. 9).

Installation

1. Clear slots in engine block of debris, using a 7/16-14 bottoming tap.
2. Install insulators to engine using new bolts and tighten to specifications (Fig. 9).
3. Replace starter and then lower the engine assembly. Move transmission jack out of the way.
4. Replace the insulator to support nuts and tighten. Install fan shroud and bolts.

ENGINE REAR SUPPORT INSULATORS

The various rear supports and insulators are illustrated in Figs. 10 and 11. Note the location of the attaching bolt holes before removing a damaged or worn part as some components have holes for other applications.

F-150—F-350 AND BRONCO

Removal

1. Remove the insulator to support assembly bolt and locknut (Fig. 10).
2. Remove the insulator to transmission housing bolts and lockwashers.

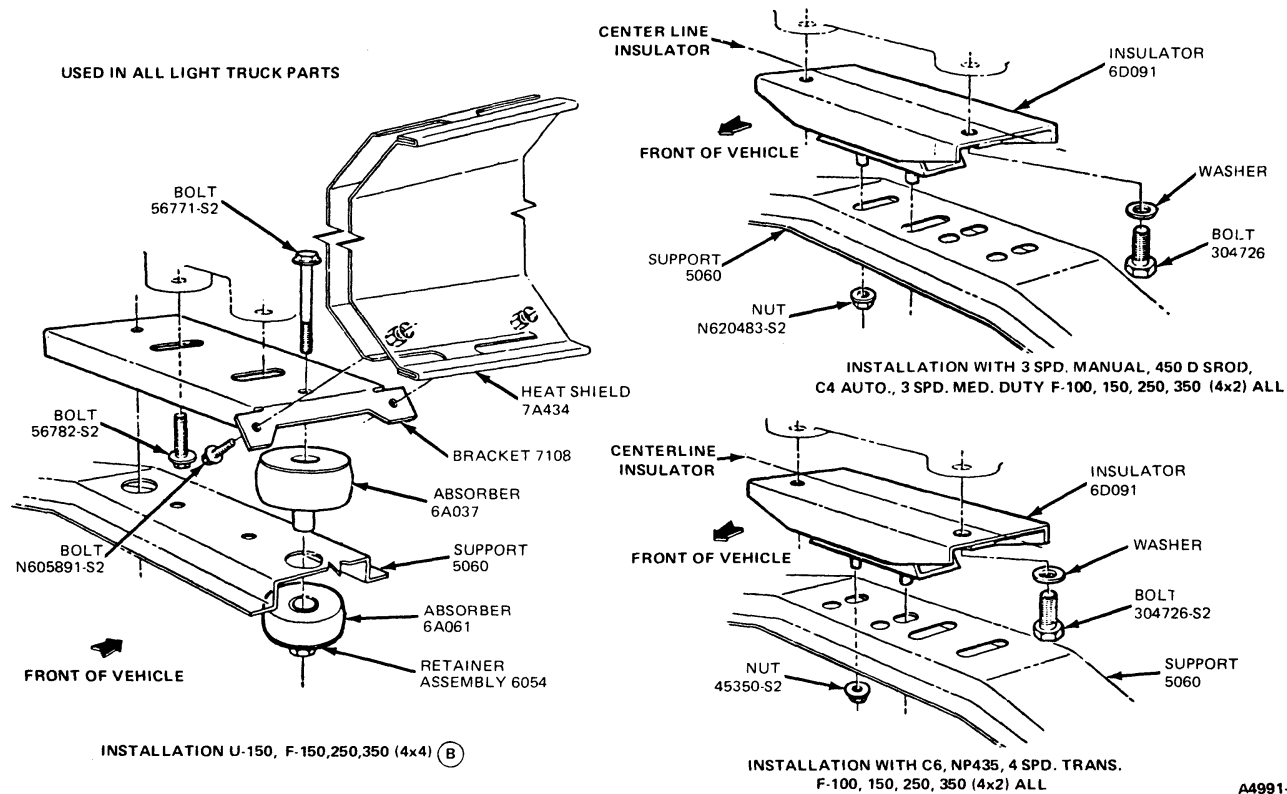


FIG. 10 Rear Support and Insulator F-150—F-350 and Bronco

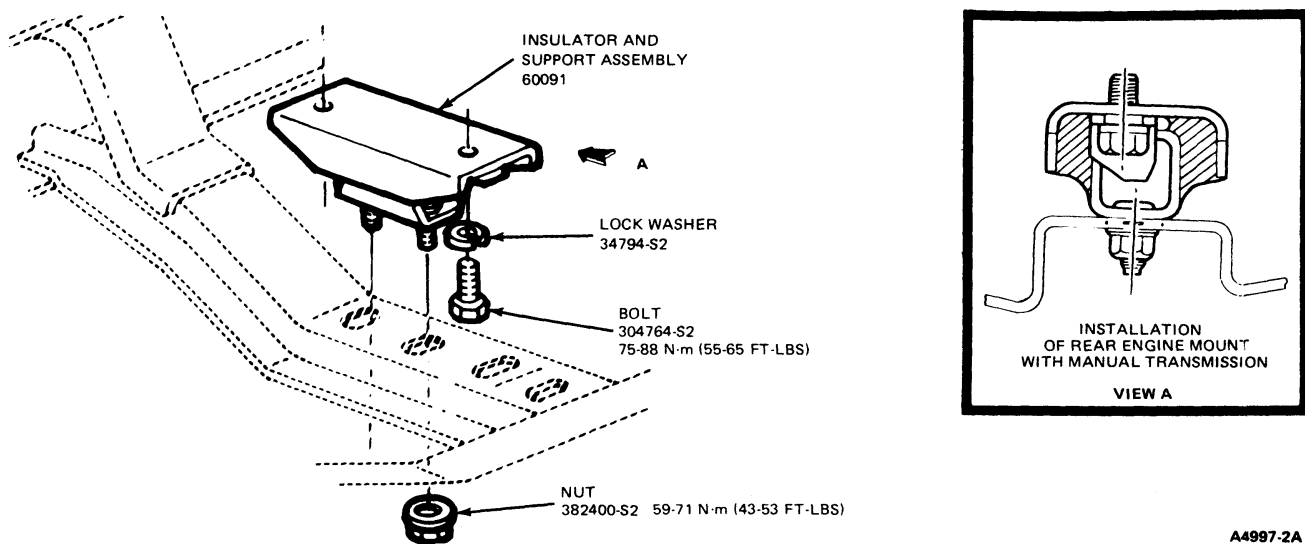


FIG. 11 Rear Support and Insulator—E-150—F-350

3. Raise the transmission with a floor jack and remove the insulator and retainer.

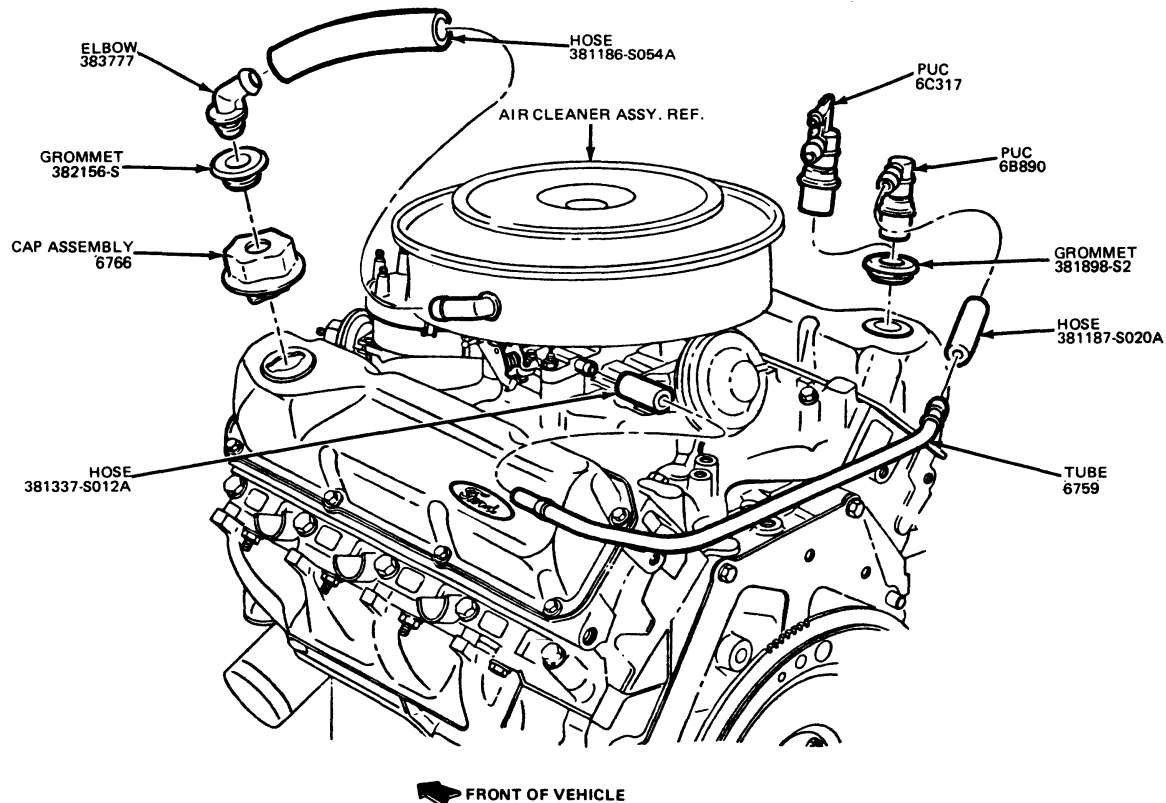
Installation

1. Position the insulator and retainer to the transmission housing and install the attaching bolts and lockwashers, using the holes noted on removal (Fig. 10). Tighten to specification.
2. Lower the transmission and remove the jack.
3. Install the insulator to support assembly bolt and locknut and tighten to specification.

E-150—E-350

Removal

1. Raise the vehicle on a hoist.
2. Remove the insulator support nuts securing the rear insulator support to the frame crossmember (Fig. 11).
3. Raise the transmission with a jack so that the insulator support clears the frame.
4. Remove the insulator support bolts securing the rear insulator support to the transmission, then remove the insulator.



A4998-2A

FIG. 12 Typical Crankcase Ventilation System Components

Installation

1. Position the insulator support, then install the bolts securing the insulator support to the transmission (Fig. 11). Tighten the bolts to specifications.
2. Lower the jack supporting the transmission and align the insulator support bolt holes with the holes in the frame assembly.
3. Install the bolts and nuts securing the insulator support to the frame. Tighten to specification.
4. Lower the vehicle.

2. Insert the PCV valve into the oil fill cap mounting grommet.
3. Connect the vent hose to the carburetor.
4. Install the air cleaner and intake duct assembly.
5. Install the ventilation system air intake hose to the air cleaner and the PCV valve.
6. Start the engine and check for leaks.

CRANKCASE VENTILATION SYSTEM

The crankcase ventilation system components are shown in Fig. 12.

Removal

1. Remove the ventilation system air intake hose from the air cleaner.
2. Remove the crankcase vent hose from the PCV valve located in oil fill cap.
3. Remove the air cleaner and intake duct assembly.
4. Disconnect the crankcase vent hose from the carburetor.
5. Pull the PCV valve out of the oil fill cap.
6. Remove the crankcase ventilation filter from the air cleaner body.

Installation

1. Install the crankcase ventilation filter in the air cleaner body.

VALVE ROCKER ARM COVER AND ROCKER ARM

The valve rocker arm is shown in Fig. 13.

Removal

1. Remove the air cleaner and intake duct assembly. Remove appropriate crankcase ventilation hose(s) at the valve rocker arm cover(s) (Fig. 12).
2. Disconnect the spark plug wires from the spark plugs by grasping, twisting and pulling the molded cap only with Tool T74P-6666-A, or equivalent. Remove the wires from the bracket on the valve rocker arm cover(s) and position the wire out of the way.
3. Remove the valve rocker arm cover(s).
4. Remove the valve rocker arm bolt, oil deflector, fulcrum seat and rocker arm.

Installation

All rocker arms and fulcrum seats are to be lubricated with heavy engine oil SE before installation.

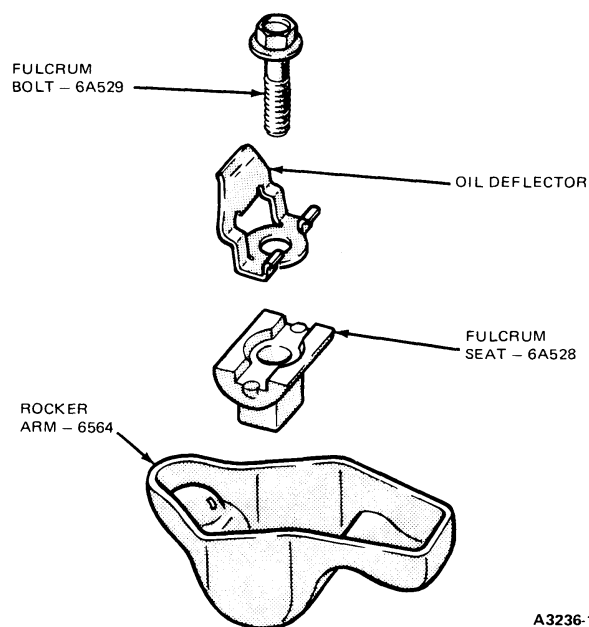


FIG. 13 Rocker Arm and Related Parts

1. Apply Lubriplate or equivalent to the top of the valve stem. Lubricate the rocker arm and fulcrum seat with heavy engine oil SE.
2. Position the No. 1 piston on TDC at the end of the compression stroke **POSITION 1** in Fig. 4, and install the rocker arm, fulcrum seat, oil deflector, and fulcrum bolts on the following valves:

No. 1 Intake No. 1 Exhaust

No. 4 Intake No. 3 Exhaust

No. 8 Intake No. 7 Exhaust

Position the crankshaft in **POSITION 2** Fig. 4 and install the rocker arm, fulcrum seat, oil deflector and fulcrum bolts on the following valves:

No. 3 Intake No. 2 Exhaust

No. 7 Intake No. 6 Exhaust

Position the crankshaft in **POSITION 3** in Fig. 4 and install the rocker arm, fulcrum seat, oil deflector and fulcrum bolts on the following valves:

No. 2 Intake No. 4 Exhaust

No. 5 Intake No. 5 Exhaust

No. 6 Intake No. 8 Exhaust

Be sure that the fulcrum seat base is seated in its slot on the cylinder head before tightening the fulcrum bolts. Tighten the fulcrum bolt to specification. Check the valve clearance following the procedures under Valve Clearance Adjustment.

3. Clean the valve rocker arm cover(s) and the cylinder head gasket surface(s). Apply oil-resistant sealer to one side of new cover gasket(s). Lay the cemented side of the gasket(s) in place in the cover(s).
4. Position the cover(s) on the cylinder head(s). Make sure the gasket seats evenly all around the head. Install the bolts. The cover is tightened in two steps. Tighten the bolts to specification. Two minutes later, tighten the bolts to the same specification.

Reconnect the crankcase ventilation hose(s) (Fig. 12).

Install the air cleaner and intake duct assembly.

5. Install the spark plug wires in the bracket on the valve rocker arm cover(s). Connect the spark plug wires.
6. Start the engine and check for leaks.

VALVE SPRING, RETAINER AND STEM SEAL

Broken valve springs or damaged valve stem seals and retainers may be replaced without removing the cylinder head, provided damage to the valve or valve seat has not occurred.

Removal

1. Remove the required rocker arm(s) following the instructions given in Rocker Arm Removal.
2. Remove the applicable spark plug. Crank the engine until the piston is at TDC at the end of the compression stroke.
3. Install an air line with an adapter in the spark plug hole and turn on the air supply (Fig. 14).
4. Install the compressor tool as shown in Fig. 14. Compress the valve spring and remove the retainer locks, spring retainer and valve spring (Fig. 48).

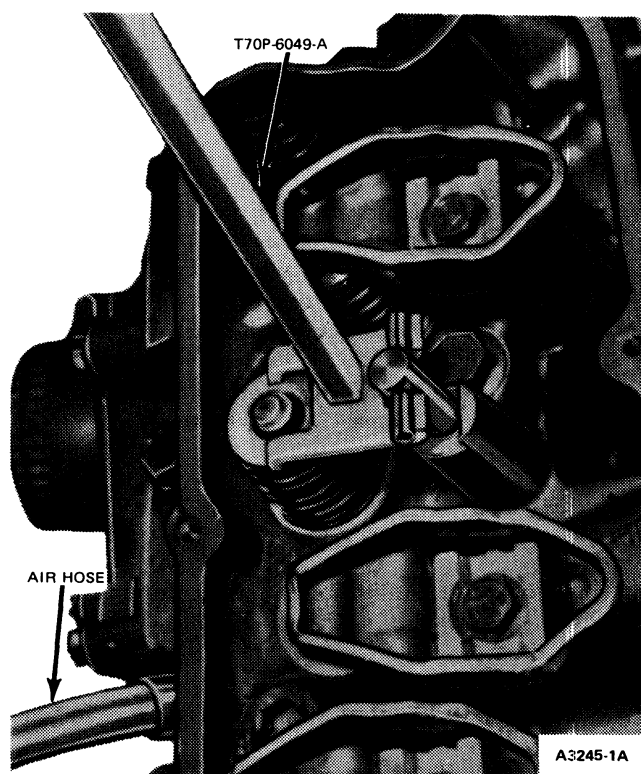
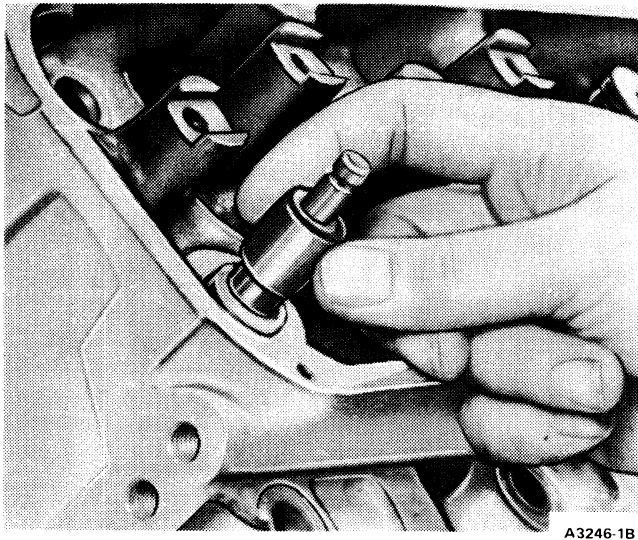


FIG. 14 Compressing Valve Spring in Chassis

5. Remove and discard the valve stem seal (Fig. 15).
6. If air pressure has forced the piston to the bottom of the cylinder, any removal of air pressure will allow the valve(s) to fall into the cylinder. A rubber band, tape or string wrapped around the end of the valve stem will prevent this condition and will still allow enough travel to check the valve for binds.



A3246-1B

FIG. 15 Removing or Installing Valve Stem Seal

Installation

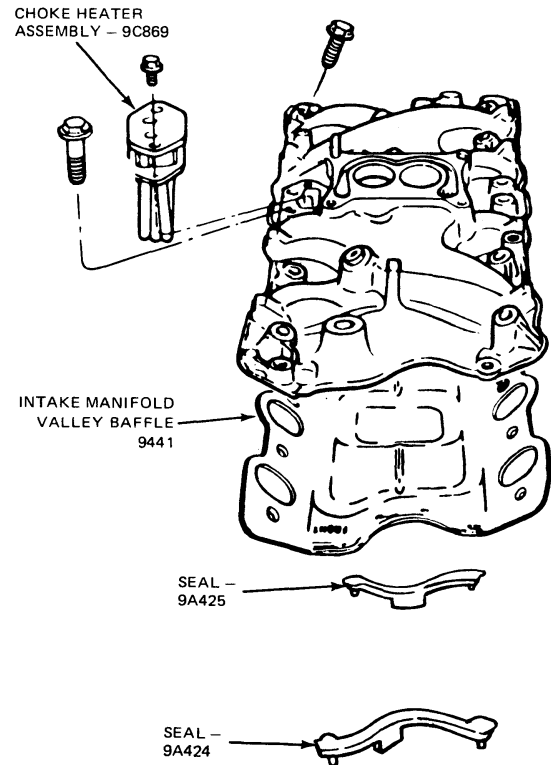
1. Inspect the valve stem for damage. Rotate the valve and check the valve stem tip for eccentric movement during rotation. Move the valve up and down through normal travel in the valve guide and check the stem for binds. **If the valve has been damaged, it will be necessary to remove the cylinder head for repairs as outlined in Part 21-01.**
2. If the condition of the valve proved satisfactory, hold the valve in the closed position and apply the air pressure within the cylinder.
3. Lubricate the valve stem with heavy engine oil SE.
4. Install a new valve stem seal (Fig. 15) use a 5/8 inch deep wall socket and a light hammer or mallet to seat the seal on the valve stem. Place the spring in position over the valve and install the valve spring retainer. Compress the valve spring and install the valve spring retainer locks. Remove the compressor tool and fulcrum bolt. Turn off the air and remove the air line adapter.
5. Lubricate and install the push rod. Apply Lubriplate or equivalent to the tip of the valve stem.
6. Install the required rocker arm(s) following the instructions given in Rocker Arm Installation.
7. Check the rocker arm to valve stem clearance and install the related parts as outlined in Valve Rocker Arm Cover and Rocker Arm Installation.

INTAKE MANIFOLD

A typical intake manifold assembly is shown in Fig. 16.

Removal

1. Remove the air cleaner and intake duct. If equipped with air conditioning isolate and remove the compressor, following the procedures in Group 36.
2. Disconnect the high tension lead and wires from the coil. Disconnect the engine wire harness and position it out of the way.



A3238-1E

FIG. 16 Intake Manifold Assembly

3. Disconnect the spark plug wires from the spark plugs by grasping, twisting and pulling the molded cap only (use Tool T68P-6666-A or equivalent).
Remove the wires from the harness brackets on the valve rocker arm covers. Remove the distributor cap and spark plug wire assembly. Remove the Thermactor by-pass valve and hose from the check valve.
4. Remove the carburetor fuel inlet line.
5. Remove the heater hoses from the retainers and position the hoses out of the way.
6. Remove the ignition coil, vacuum solenoid valve, and bracket.
7. Disconnect the crankcase emission hose at the left rocker arm cover.
8. Disconnect the vacuum lines from the intake manifold.
9. Disconnect the distributor vacuum hoses from the distributor. Remove the distributor hold down bolt and clamp and remove the distributor, following the procedure in Part 23-01 for breakerless ignition systems. Block the distributor hole with a cloth to prevent entry of foreign material into the crankcase.
10. Disconnect the accelerator linkage and transmission downshift linkage, if so equipped, and position out of the way. Disconnect the speed control cable, if so equipped.
11. Remove the carburetor.
12. Remove the manifold attaching bolts. Remove the manifold. Remove and discard the intake manifold valley baffle and seals.

13. If the manifold assembly is to be disassembled, disconnect vacuum hoses.
14. Remove the carburetor spacer, EGR valve and inspect passages in the spacer for erosion. Clean and check the surfaces for flatness.

Installation

1. Clean the mating surfaces of the intake manifold, cylinder heads and cylinder block. Use a solvent such as lacquer thinner, chlorothane or tri-chloroethylene. Apply a 1/8 inch bead of silicone rubber sealer at the points shown in Fig. 17. **Caution: Do not apply sealer to waffle section of end seals as the sealer will rupture the seal material.**
2. Position new seals on the cylinder block and press the seal locating extensions into the holes in the mating surface.
3. Apply a 1/16 inch bead of the above sealer to the outer end of each intake manifold seal for the full width of the seal (4 places). See Fig. 17. **CAUTION: DO NOT APPLY SEALER TO WAFFLE SECTION OF END SEALS AS THE SEALER WILL RUPTURE THE SEAL MATERIAL.** **Note: This sealer sets up in 15 minutes, so it is important that assembly be completed promptly. Do not drip any sealer into the engine valley. Position the intake manifold valley baffle onto the block and cylinder heads with the alignment notches under the dowels on the cylinder heads. Be sure the holes in the valley baffle are aligned with the holes in the cylinder head.**

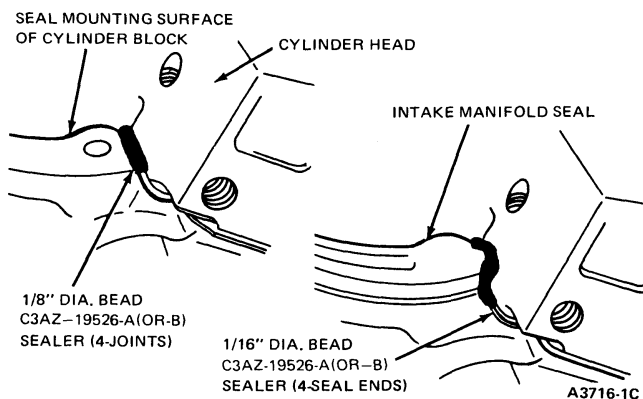


FIG. 17 Typical RTV Sealer Installation—Intake Manifold

4. Carefully lower the intake manifold into position on the cylinder block and cylinder heads.
5. Be sure the holes in the manifold gaskets and manifold are in alignment. Install the intake manifold attaching bolts. Tighten the intake manifold bolts in three steps following specifications listed at the end of this part and in order shown in Fig. 18.

After completing the remaining assembly steps, operate the engine until it reaches normal operating temperature then re-tighten the manifold bolts in sequence to specification.

6. Install the spacer, carburetor and new gaskets. If removed, install EGR valve.

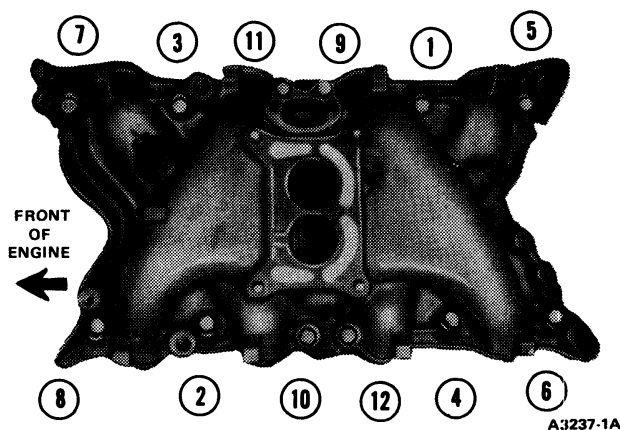


FIG. 18 Intake Manifold Torque Sequence

7. Install the distributor following the procedure in Part 23-01 for breakerless ignition systems.
8. Install the accelerator linkage and transmission downshift rod, if so equipped. Install speed control cable, if so equipped.
9. Install the vacuum solenoid valve and the ignition coil.
10. If the intake manifold vacuum fitting was removed, clean mating surfaces of manifold and fitting with trichlorethylene (or equivalent). Apply Loctite No. 242 thread locker (D5AZ-19554-A) or equivalent to the threads of the fitting. Install fitting into the manifold. Allow 30 minutes for sealant to cure before operating the vehicle.
11. Connect the vacuum lines at the manifold. Install the Thermactor bypass air supply hose.
12. Position the engine wire harness under the hold down clips on the left rocker arm cover and connect the wires at the ignition coil, water temperature sending unit and throttle solenoid.
13. Connect the crankcase emission line at the left hand rocker arm cover.
14. Install the heater hoses in the retainers.
15. Connect the fuel pump to carburetor fuel line at the carburetor.
16. Install the distributor cap. Position the spark plug wires in the harness brackets on the valve rocker arm covers and connect the wires to the spark plugs. On vehicles equipped with air conditioning, install compressor following procedure in Group 36.
17. Start the engine and check for leaks. Adjust the ignition timing to settings listed on the engine specifications decal and connect the distributor vacuum lines.
18. When engine temperature has stabilized, adjust idle to specifications on engine decal. Retighten intake manifold bolt to specification.
19. Install the air cleaner and re-check idle speed.

VALVE TAPPET

Before replacing a hydraulic valve tappet for noisy operation, be sure the noise is not caused by improperly adjusted valve clearance (collapsed tappet clearance) or by worn rocker arms or push rods.

The following procedure applies to the removal of one or all valve tappets. **NOTE: Since not all push rod holes are large enough to permit the removal of the associated tappet, it may be necessary to remove the adjacent rocker arm and pushrod and use that pushrod hole for access.**

Removal

1. Remove the valve rocker arm covers.
2. Remove the necessary valve rocker arm(s) push rod(s) and identify them so that they can be installed in their original positions.
3. Using Tool T70P-14151 or equivalent remove the valve tappet(s) and place them in a rack so that they can be installed in their original bores (Fig. 19). If removing tappet through adjacent lifter hole, use a small light to aid in transferring tappet into position for lifting out with T70P-14151 Tool or equivalent.

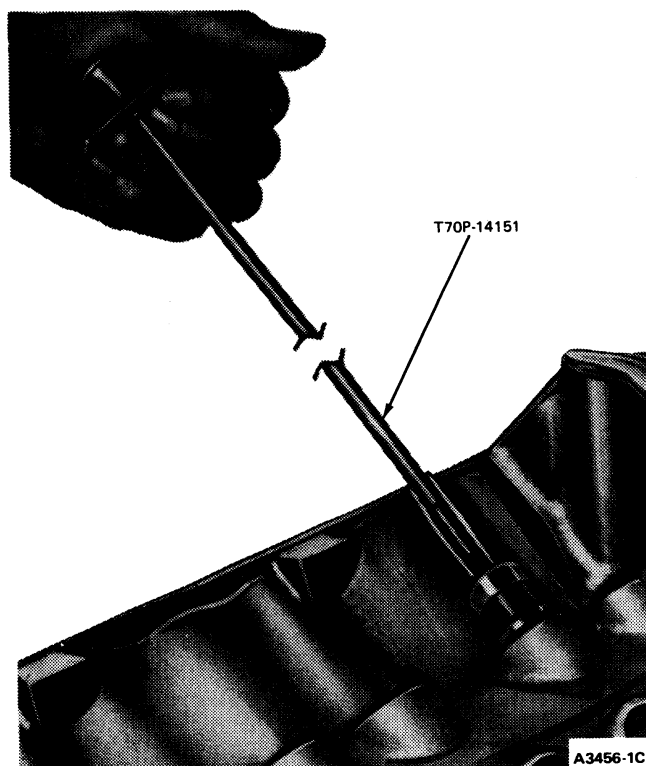


FIG. 19 Removing Hydraulic Valve Tappet

4. Instructions for disassembling and assembling the tappets are given in Valve Tappets—Disassembly and Assembly in this Part.

Installation

Tappets and bores are to be lubricated with heavy engine oil SE before installation.

1. Clean the external surfaces of the valve tappets and install in the bores from which they were removed. If a new tappet is being installed, check the new tappet(s) for a free fit in the bore in which it is to be installed. Lubricate the tappet and bore(s) with heavy engine oil SE before inserting it in the bore.
2. Install the push rods in their original position. Apply Lubriplate or equivalent to the valve stem tips.

3. Install the rocker arm(s) following the instructions given in Rocker Arm Installation in this Part.
4. Check the rocker arm to valve stem tip clearance listed in the Specifications at the end of this Part (collapsed tappet clearance), and install the related parts as outlined in Valve Rocker Arm Cover and Rocker Arm Installation in this Part.

EXHAUST MANIFOLD

Removal

1. If a right exhaust manifold is being removed, remove the air cleaner, intake duct and heat stove. If a left-hand exhaust manifold is being removed, first remove the oil filter. On the left-hand exhaust manifold remove the oil dipstick and the tube assembly and the speed control bracket, if so equipped.
2. On vehicles equipped with a column selector and automatic transmission, disconnect the selector lever cross shaft for clearance.
3. Disconnect the muffler inlet pipe or catalytic converter at the exhaust manifold. Remove the spark plug heat shields.
4. Remove the exhaust manifold attaching bolts and remove the manifold.

Installation

1. Clean the mating surfaces of the exhaust manifold and cylinder head. Clean the mounting flange of the exhaust manifold and muffler inlet pipe or catalytic converter.
2. Apply graphite grease to the mating surface of the exhaust manifold.
3. Position the exhaust manifold on the head and install the attaching bolts. On the left hand exhaust manifold install the oil dipstick tube assembly and the speed central brackets, if so equipped. Working from the center to the ends, tighten the bolts to specification. Install the spark plug heat shields.
4. Install the spacer between the inlet pipe and the exhaust manifold.
5. Connect the muffler inlet pipe or catalytic converter at the exhaust manifold. Tighten the attaching nuts to specifications listed in Part 26-01, General Exhaust System Service.
6. If a left exhaust manifold is being installed, install the oil filter.

On a vehicle with an automatic transmission and column selector, connect the selector cross shaft at the chassis and cylinder block.

7. If a right exhaust manifold is being replaced, install the air cleaner heat stove. Install the air cleaner and intake duct.
8. Start the engine and check for exhaust leaks.

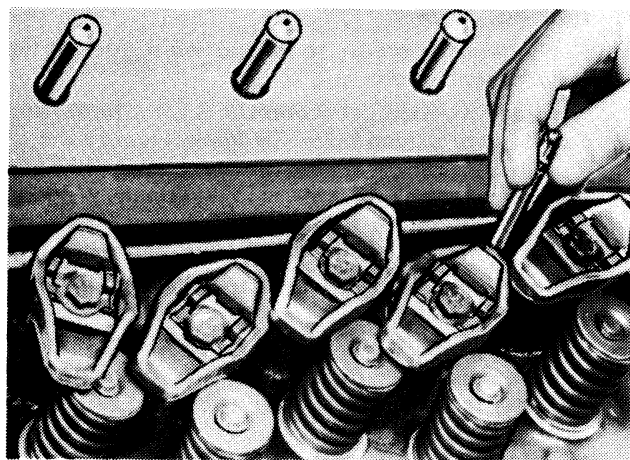
CYLINDER HEADS

If a cylinder head is to be replaced, follow the procedures under Cylinder Head Disassembly and Assembly, and transfer all valves, springs, spark plugs, etc., to the new cylinder head. Clean and inspect all parts, reface the valves (refer to Part 21-01) and check

all assembly clearances before assembling the new or used parts to the new cylinder head.

Removal

1. Remove the intake manifold and carburetor as an assembly following the procedure under Intake Manifold Removal.
2. Remove the rocker arm cover(s).
If the left cylinder head is to be removed on a vehicle with an air conditioner, isolate and remove the compressor as outlined in Group 36.
If the left cylinder head is to be removed, disconnect the power steering pump bracket from the left cylinder head and remove the drive belt from the pump pulley. Position the power steering pump out of the way and in a position that will prevent the oil from draining out.
3. If the right cylinder head is to be removed, remove the alternator mounting bracket through bolt and air cleaner inlet duct from the right cylinder head assembly. Remove the ground wire at the rear of the cylinder head.
4. Disconnect the exhaust manifold(s) from the muffler inlet pipe(s) or catalytic converter(s).
5. Remove the rocker arm bolts, oil deflectors, fulcrum seats, rocker arms, and push rods in sequence (Fig. 20) so that they may be installed in their original positions.
6. Install Cylinder Head Holding Fixture T62F-6085-A or equivalent on cylinder head.



A3240-1B

FIG. 20 Removing Valve Push Rod

7. Remove the cylinder head attaching bolts and lift the cylinder head off the block using the holding fixture. Remove and discard the cylinder head gasket.

Note: On E-150—E-350, it may be necessary to remove the forward bolt on the L.H. side with the cylinder head due to the close proximity of the body flange.

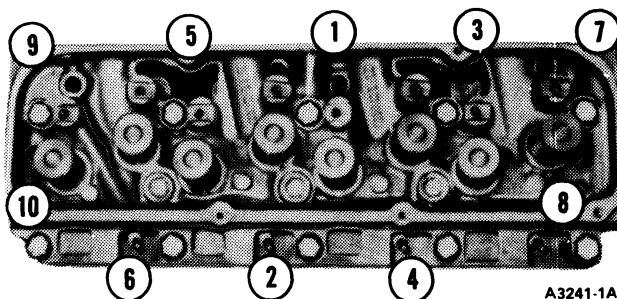
Installation

1. Clean the cylinder head, intake manifold, valve rocker arm cover and cylinder head gasket surfaces. If the cylinder head was removed for a cylinder head gasket replacement, check the flatness of the cylinder head and block gasket surfaces.

2. Position the new cylinder head gasket over the cylinder dowels on the block. Position the cylinder head on the block and install the attaching bolts. Remove the holding fixture T62F-6085-A.

NOTE: On E-150—E-350, it may be necessary to install the forward bolt on the L.H. side with the cylinder head. Prior to installing the cylinder head, to allow easy installation and to prevent damage to the cylinder head gasket, insert the bolt part way into the cylinder head and hold in place using wire or a rubber band. Remove the wire or rubber band after the cylinder head is in position.

3. The cylinder head bolts are tightened in three progressive steps. Tighten all the bolts in sequence (Fig. 21) to Specifications listed at the end of this Part. When cylinder head bolts have been tightened following this procedure, it is not necessary to retorquing the bolts after extended operation. However, the bolts may be checked and retorqued if desired.



A3241-1A

FIG. 21 Cylinder Head Bolt Torque Sequence

4. Clean the push rods in a suitable solvent. Blow out the oil passage in the push rod with compressed air. Check the ends of the push rods for nicks, grooves, roughness or excessive wear. Visually check the push rods for straightness or check push rod runout with a dial indicator. If runout exceeds the maximum limit at any point, discard the rod. **Do not attempt to straighten push rods.**
5. Lubricate and install the push rods in their original positions. Apply Lubriplate or equivalent to the valve stem tips.
6. Lubricate and install the rocker arms following procedures under Valve Rocker Arm Installation in this Part.
7. Connect the exhaust manifold(s) at the muffler inlet pipe(s) or catalytic converter(s). Tighten the nuts to specifications listed in Part 26-01, General Exhaust System Service.
8. If the right cylinder head was removed, install the alternator mounting bracket through bolt and air cleaner inlet duct on the right cylinder head assembly. Connect the ground wire at the rear of the cylinder head. Adjust the drive belt tension to specifications listed at the end of this Part.
9. Apply sealer to the rocker cover and cover gasket to hold gasket in place. Position gasket on cover aligning the holes in cover and gasket. Install the valve rocker arm cover(s).

If the left cylinder head was removed on a vehicle with an air conditioner, install the compressor as outlined in Group 36.

If the left cylinder head was removed, install the drive belt and power steering pump bracket. Install the bracket attaching bolts. Adjust the drive belt to specifications listed at the end of this Part.

10. Install the intake manifold and related parts following the procedure under Intake Manifold Installation in this Part.

WATER PUMP

Removal

1. Drain the cooling system (refer to Part 27-02, General Cooling System Service) and disconnect the battery.
2. Remove the fan shroud attaching bolts and position the shroud rearward.
3. Remove the fan and spacer from the water pump shaft.
4. Remove the air conditioner compressor drive belt lower idler pulley and compressor mount to water pump bracket, if so equipped (refer to Group 36).
5. Loosen the alternator and remove the drive belt.
6. Loosen the power steering pump and remove the drive belt.
7. Remove the water pump pulley.
8. Remove the alternator bracket from water pump and position it out of the way.
9. Remove the power steering pump bracket from the water pump and position it out of the way.
10. Remove the heater hose from the water pump.
11. Disconnect the radiator lower hose at the water pump.
12. Remove the water pump attaching bolts and remove the water pump.

Installation

1. Remove all gasket material from the mounting surfaces of the cylinder front cover and water pump.
2. Position a new gasket, coated on both sides with sealer, on the cylinder front cover. Then install the pump. Coat the threads of the attaching screws with oil-resistant sealer and install the screws. Tighten the attaching screws to specification.
3. Install the air conditioner compressor to water pump bracket and lower idler pulley, if so equipped (refer to Group 36).
4. Position the alternator bracket and power steering pump bracket on the water pump and install the bracket bolts.
5. Position the water pump pulley on the water pump shaft and install the drive belts.
6. Place the fan shroud over the pulley and install the fan and spacer.
7. Install the fan shroud attaching bolts.
8. Adjust the drive belts to specification listed at the end of this part.
9. Connect the radiator lower hose at the water pump.

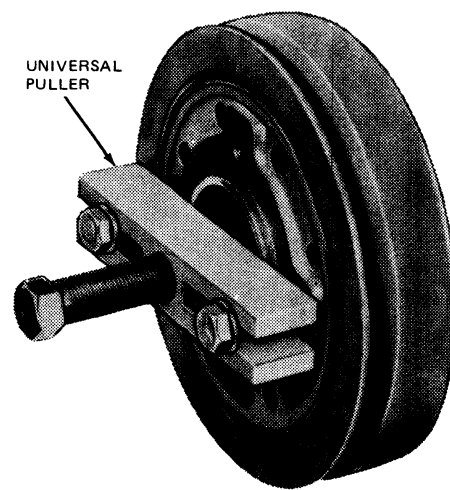
10. Connect the heater hose at the water pump.

11. Connect the battery cable. Fill and bleed the cooling system (refer to Part 27-02, General Cooling System Service). Operate the engine until normal operating temperature has been reached and check for leaks.

CYLINDER FRONT COVER PLATE AND TIMING CHAIN

Removal

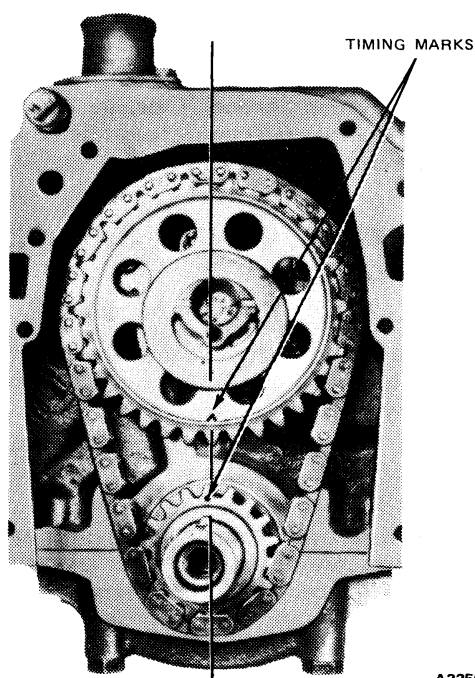
1. Refer to Water Pump Removal. Perform Steps 1 thru 9, but leave the water pump attached to the front cover plate.
2. Remove the heater hose and lower radiator hose from the water pump.
3. Remove the crankshaft pulley from the crankshaft vibration damper. Remove the vibration damper attaching screw. Install the puller on the crankshaft vibration damper (Fig. 22) and remove the vibration damper.



A3248-1A

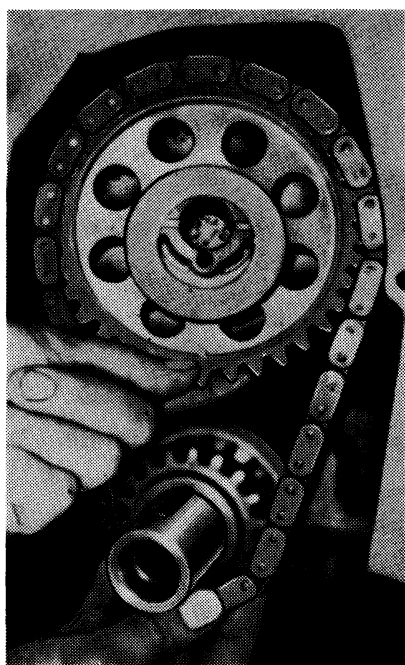
FIG. 22 Remove Crankshaft Vibration Damper

4. Remove the timing pointer.
5. Remove the bolts attaching the front cover plate and water pump to the cylinder block. Remove the front cover plate and water pump assembly.
6. Disconnect the fuel pump outlet line from the fuel pump. Remove the fuel pump attaching bolt and nut and lay the pump to one side with the flexible fuel line still attached.
7. Discard the cylinder front cover plate gasket and oil pan seal.
8. Check the timing chain deflection (refer to Part 21-01).
9. Crank the engine until the timing marks on the sprockets are positioned as shown in Fig. 23.
10. Remove the camshaft sprocket cap screw, washer and two piece fuel pump eccentric. Slide both sprockets and the timing chain forward, and remove them as an assembly (Fig. 24).



A3250-1A

FIG. 23 Aligning Timing Marks

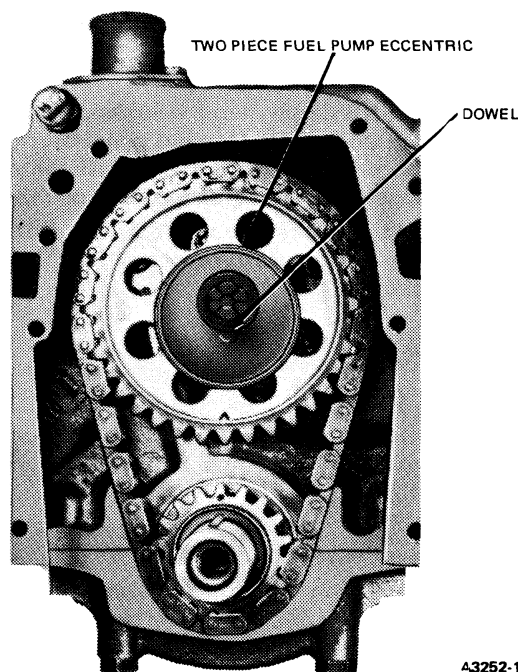


A3251-1A

FIG. 24 Removing or Installing Timing Chain

Installation

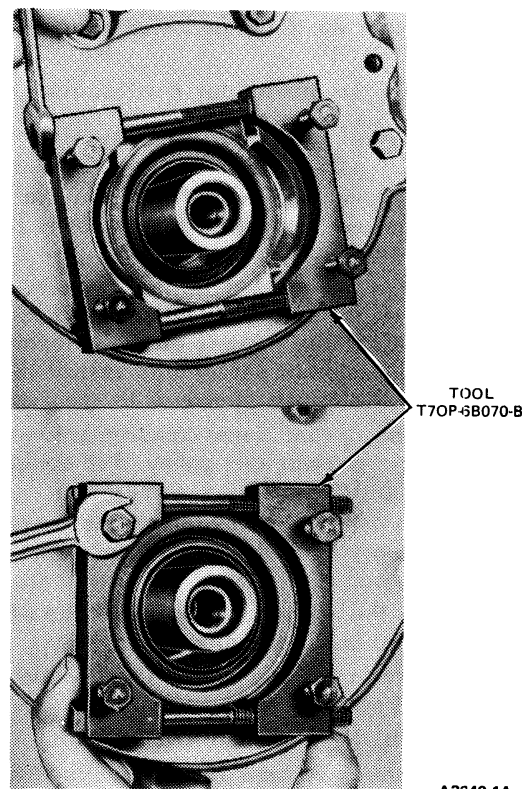
1. Position the sprockets and timing chain on the camshaft and crankshaft (Fig. 24). Be sure the timing marks on the sprockets are positioned as shown in Fig. 23.
2. Install the two-piece fuel pump eccentric, washers and camshaft sprocket cap screw (Fig. 25). Tighten the sprocket cap screw to specification. **Be sure the outer eccentric sleeve rotates freely.**



A3252-1B

FIG. 25 Fuel Pump Eccentric Installed

3. Coat a new fuel pump gasket with oil-resistant sealer and position the fuel pump and gasket on the cylinder block with pump arm resting on the eccentric outer sleeve. Install the pump attaching bolt and nut and tighten to specification. Connect the fuel pump outlet line.
4. Place the front seal removing Tool onto the front cover plate over the front seal as shown in Fig. 26.



A3249-1A

FIG. 26 Removing Crankshaft Front Seal

5. Alternately tighten the four puller bolts a half turn at a time to pull the oil seal from the front cover.
6. Clean the cylinder front cover plate and the engine block gasket surfaces.
7. Coat the gasket surfaces of the block and cover with sealer, and position a new gasket on the cylinder block alignment dowels.
8. Position the cylinder front cover plate and water pump assembly on the cylinder block alignment dowels.
9. Coat the threads of the attaching bolts with oil-resistant sealer and install the timing pointer and attaching bolts. Tighten the bolts to specification.
8. Install the front crankshaft seal into the cylinder front cover plate with the tool shown in Fig. 27.
10. Coat a new front cover plate oil seal with Lubriplate or equivalent and place it onto the front oil seal and alignment sleeve as shown in Fig. 27. Place the sleeve and seal onto the end of the crankshaft and push the seal toward the engine until the seal starts into the front cover.
11. Place the installation screw, washer and nut onto the end of the crankshaft. Thread the screw into the crankshaft. Tighten the nut against the washer and installation sleeve to force the seal into the front cover plate. Remove the installation tool from the crankshaft.

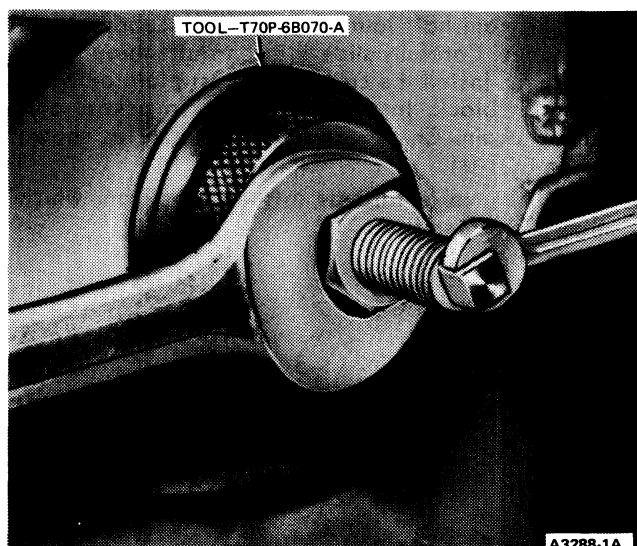


FIG. 27 Installing Front Crankshaft Seal

12. Apply Lubriplate or equivalent to the oil seal rubbing surface of the vibration damper inner hub to prevent damage to the seal. Apply a white lead and oil mixture to the front of the crankshaft for damper installation.
13. Line up the crankshaft vibration damper keyway with the key on the crankshaft. Install the vibration damper on the crankshaft using Tool T52L-6306-AEE (or 6306-AJ) or equivalent (Fig. 28). Install the cap screw and washer. Tighten the cap screw to specification. Install the crankshaft pulley.
14. Connect the heater hose and the radiator lower hose at the water pump.

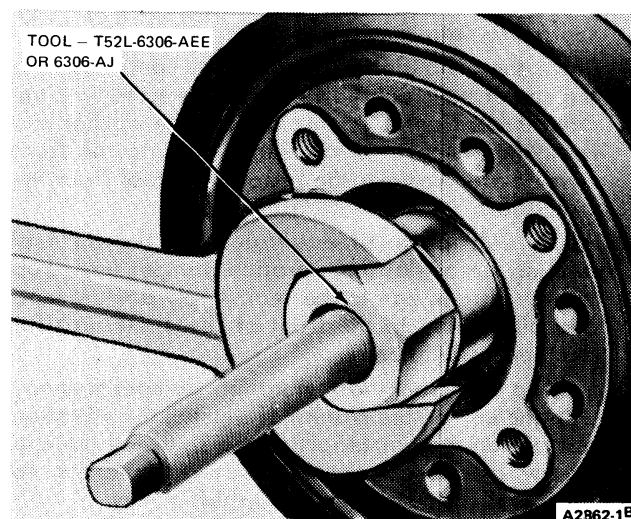


FIG. 28 Installing Crankshaft Vibration Damper

15. Refer to Water Pump Installation in this Part and complete Steps 3 thru 10 to install the necessary parts, fill and bleed the cooling system, etc.
16. Raise the vehicle. Remove the oil pan and install new gaskets and seals following procedures under Oil Pan Removal and Installation in this Part.
17. Lower the vehicle.
18. Fill the crankcase with the proper grade and quantity of engine oil. Fill and bleed the cooling system (refer to Part 27-02, General Cooling System Service).
19. Connect the battery. Operate the engine until normal operating temperature has been reached and check for leaks.

FRONT OIL SEAL

Removal

1. Remove the bolts attaching the fan shroud to the radiator.
2. Remove the fan and spacer bolts from the water pump shaft. Remove the fan, spacer and shroud.
3. Loosen the alternator, power steering, Thermactor and air conditioner drive belts, if so equipped. Remove the drive belts.
4. Remove the crankshaft pulley from the vibration damper. Remove the damper attaching screw and washer. Install the puller on the crankshaft vibration damper (Fig. 22) and remove the vibration damper.
5. Place the front seal removing tool onto the front cover plate over the front seal as shown in Fig. 26. Tighten the two through bolts to force the seal puller under the seal flange.
6. Alternately tighten the four puller bolts a half turn at a time as shown in Fig. 26 to pull the oil seal from the front cover.

Installation

1. Coat a new front cover plate oil seal with Lubriplate or equivalent and place it onto the front oil seal alignment and installation sleeve as shown in Fig. 27. Place the sleeve and seal onto the end of the

- crankshaft and push it toward the engine until the seal starts into the front cover.
- Place the installation screw, washer and nut onto the end of the crankshaft. Thread the screw into the crankshaft. Tighten the nut against the washer and installation sleeve to force the seal into the front cover plate. Remove the installation tool from the crankshaft.
 - Apply Lubriplate or equivalent to the oil seal rubbing surface of the vibration damper inner hub to prevent damage to the seal. Apply a white lead and oil mixture to the front of the crankshaft for damper installation.
 - Line up the crankshaft vibration damper keyway with the key on the crankshaft. Install the vibration damper on the crankshaft (Fig. 28). Install the cap screw and washer. Tighten the screw to specification. Install the crankshaft pulley.
 - Install the alternator, power steering pump, Thermactor and air conditioner belts, if so equipped.
 - Position the fan shroud over the water pump pulley. Install the fan and spacer. Install the fan shroud attaching screws.
 - Adjust the drive belts to specification listed at the end of this Part.

CAMSHAFT

The camshaft and related parts are shown in Fig. 29.

Removal

- Drain the cooling system. Disconnect the upper and lower radiator hoses at the radiator. Disconnect the oil cooler lines at the radiator. Remove the radiator (refer to Part 27-04, Radiators). If equipped with air conditioning, remove the condenser (refer to Group 36).

- Remove the cylinder front cover plate, fuel pump and the timing chain following the procedure under the Cylinder Front Cover Plate and Timing Chain Removal in this Part.
- Remove the intake manifold following the procedure under Intake Manifold Removal in this Part.
- Remove the valve rocker arm covers. Loosen the valve rocker arm fulcrum bolts and rotate the rocker arms to the side.
- Remove the valve push rods and identify them so that they can be installed in their original positions.
- Using the tool shown in Fig. 19, remove the valve tappets and place them in a rack so that they can be installed in their original bores.

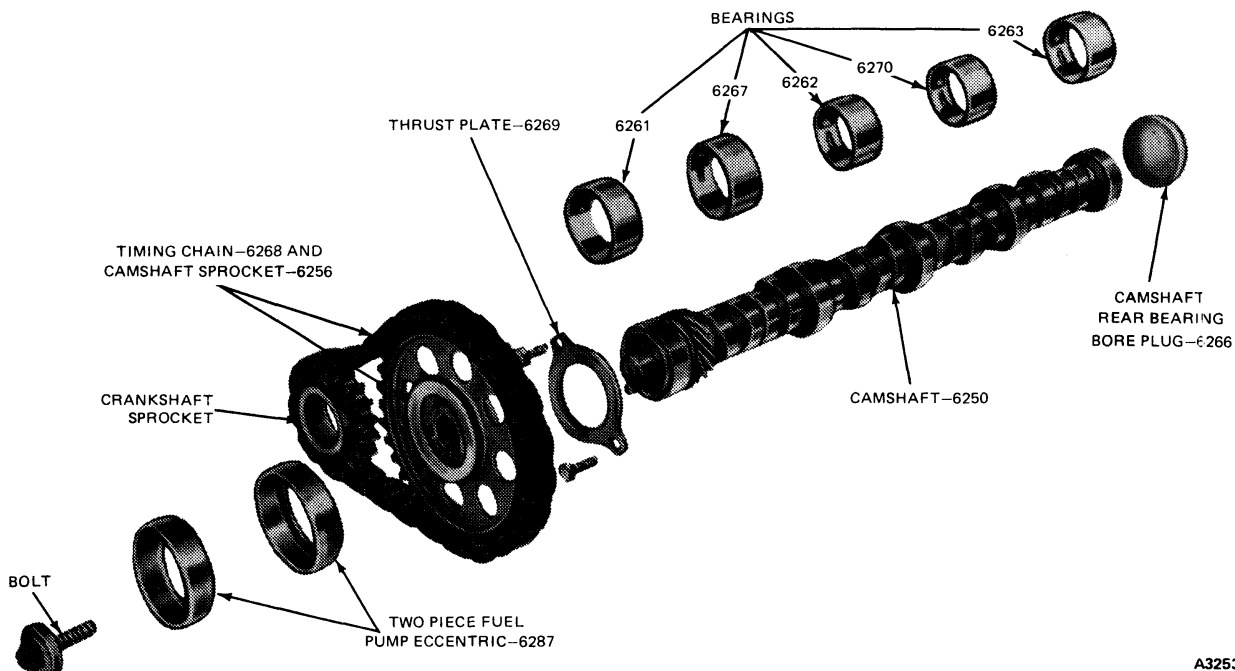
Rotate the tappets back and forth to loosen it from the gum or varnish that may have formed at the tappets.

- Be sure the Number 1 piston is in the TDC position. Remove the camshaft thrust plate. Carefully remove the camshaft by pulling toward the front of the engine. **Use caution to avoid damaging the camshaft bearings.**

Installation

Camshaft lobes are to be coated with Lubriplate or equivalent and the journals lubricated with heavy engine oil SE before installation.

- Oil the camshaft journal and apply Lubriplate to the lobes. Carefully slide the camshaft through the bearings. Install the camshaft thrust plate onto the cylinder block. Install the timing sprockets and timing chain. Check camshaft end play as shown in Part 21-01.
- Install the valve tappets in the bores from which they were removed.



A3253-2B

FIG. 29 Camshaft and Related Parts

3. Install fuel pump cylinder front cover plate and related parts following Steps 1 thru 13 under Cylinder Front Cover Plate and Timing Chain Installation in this Part.
4. Adjust the drive belts to specification listed at the end of this Part.
5. Install the push rods in their original positions.
6. Install the rocker arms following the procedure given in Rocker Arm Installation in this Part.
7. Install the rocker arm covers following the procedure given in Rocker Arm Cover Installation in this Part.
8. Install the intake manifold, distributor and related parts by following procedures under Intake Manifold Installation in this Part.
9. Connect the accelerator cable and retracting spring. Connect the transmission in this Part, equipped. Install the vacuum lines that were disconnected from the intake manifold during removal.
10. Clean and install the crankcase ventilation system.
11. Install the distributor cap. Position the spark plug wires in the harness brackets on the valve rocker arm covers and connect the wires to the plugs. Connect the high tension lead at the coil.
12. If equipped with air conditioning, install the condenser (refer to Group 36).
13. Place the radiator shroud over the fan. Install the radiator and connect the hoses (refer to Part 27-04, Radiators). Connect the transmission oil cooler lines at the radiator. On vehicles so equipped, install the radiator shroud attaching bolts.
14. Raise the vehicle. Remove the oil pan and install new gaskets and seals following procedures under Oil Pan Removal and Installation in this Part.
Lower the vehicle. On vehicles so equipped, install the fan shroud attaching bolts.
15. Fill and bleed the cooling system (refer to Part 27-02, General Cooling System Service). Fill the crankcase with the proper grade and quantity of engine oil.
16. Start the engine and check and adjust the ignition timing to settings listed on the engine specifications decal. Connect the distributor vacuum lines.
17. Operate the engine at fast idle and check all hose connections and gaskets for leaks. When the engine temperature has stabilized adjust the engine idle speed to specifications on engine decal.
18. Adjust the transmission throttle linkage. Install the air cleaner and intake duct assembly.

FLYWHEEL

Removal

1. Remove the transmission, following the procedure in Group 16 (Clutch and Manual Transmission) or Group 17 (Automatic Transmission).
2. On a manual-shift transmission, remove the clutch pressure plate and cover assembly and clutch disc, following the procedure in Group 16.
3. Remove the flywheel attaching bolts and remove the flywheel.

To check flywheel face runout or replace the flywheel ring gear, refer to Part 21-01.

Installation

1. Position the flywheel on the crankshaft flange. Coat the threads of the flywheel attaching bolts with oil resistant sealer and install the bolts. Tighten the bolts in sequence across from each other to specifications.
2. On a manual-shift transmission, install the clutch disc and the pressure plate and cover assembly following the procedure in Group 16.
3. Install the transmission following the procedure in Group 16 or Group 17.

CAMSHAFT REAR BEARING BORE PLUG

Removal

1. Remove the transmission following the procedure in Group 16 or 17.
2. Remove the flywheel attaching bolts and remove the flywheel. Remove the engine rear cover plate.
3. Remove the core plug as detailed in Part 21-01.

Installation

1. Using Tool T70P-6011-A or equivalent install the core plug as outlined in Part 2101.
2. Coat the flywheel attaching bolts with oil-resistant sealer. Position the engine rear cover plate on the cylinder block dowels. Position the flywheel on the crankshaft flange. Install and tighten the attaching bolts in sequence across from each other to specification.

Install the transmission following the procedure in Group 16 or 17.

OIL PAN

F-150-F-350 AND BRONCO

Removal

1. Remove the oil level dipstick.
2. Remove the fan shroud attaching bolts and position the fan shroud over the fan.
3. Raise the vehicle.
4. Drain the crankcase.
5. Disconnect the starter cable and remove the starter (refer to Group 28).
6. Support the engine with a jack and a wood block placed under the oil pan.
7. Remove the engine front support through bolts.
8. Raise the engine and place wood blocks between the engine supports and chassis brackets. Remove the jack.
9. Remove the oil pan attaching bolts.
10. If equipped with an automatic transmission, position the oil cooler lines out of the way.
11. Remove the oil pan.

Installation

1. Clean the gasket surfaces of the block and oil pan. The oil pan has a two-piece gasket.
2. Clean the oil pump pick-up tube and screen.

3. Coat the block surface and the oil pan gasket with sealer. Position the oil pan gaskets on the cylinder block (Fig. 30).

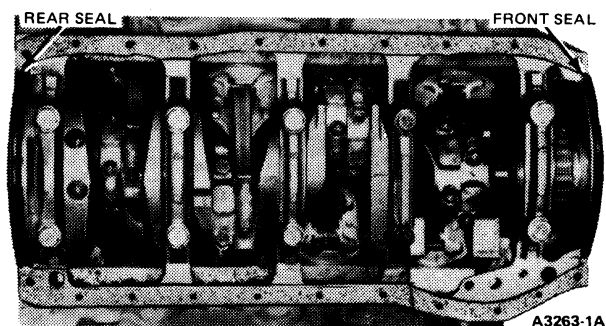


FIG. 30 Oil Pan Gasket and Seals Installed—Typical

4. Position the oil pan front seal on the cylinder front cover plate. Be sure the tabs on the seal are over the oil pan gasket.
5. Position the oil pan rear seal on the rear main bearing cap (Fig. 30). Be sure the tabs on the seal are over the oil pan gasket.
6. Position the oil pan against the block and install a bolt, finger tight, on each side of the block. Install the remaining bolts. Tighten the bolts from the center outward in each direction to specification listed at the end of this Part. Support the engine with a jack.
7. Raise the engine and remove the wood blocks from between the engine supports and chassis brackets. Lower the engine and install the engine support through bolts. Tighten the bolts to specification.
8. Remove the jack and wood block supporting the engine.
9. Install the starter and connect the starter cable (refer to Group 28).
10. Lower the vehicle.
11. Install the fan shroud attaching bolts.
12. Install the oil level dipstick. Fill the crankcase with the proper grade and quantity of engine oil. Start the engine and operate at idle speed until it reaches normal operating temperature. Check for oil leaks.

E-150—E-350

Removal

1. Open hood and disconnect battery. Open door and remove engine cover. Remove air cleaner. Drain cooling system (refer to Part 27-02, General Cooling System Service).
2. Disconnect radiator upper hose. Remove fan shroud bolts and oil filler tube. Remove oil dipstick to exhaust manifold bolt. Raise vehicle on hoist.
3. Remove splash shield under alternator. If so equipped, disconnect transmission cooler lines at radiator. Disconnect radiator lower hose.
4. Disconnect fuel line at pump. Remove engine mount nuts. Drain crankcase. Remove the dipstick tube from oil pan. Disconnect muffler inlet pipe from manifolds.

5. If so equipped, remove automatic transmission dipstick and tube. Disconnect manual linkage at transmission. Remove center driveshaft support and remove driveshaft from transmission.
6. Place a transmission jack under the oil pan and insert a 1 3/4 inch wooden block between the pan and jack. **THE ENGINE AND TRANSMISSION ASSEMBLY WILL PIVOT AROUND THE REAR ENGINE MOUNT. THE ENGINE ASSEMBLY MUST BE RAISED TWO INCHES MEASURED FROM THE FRONT MOTOR MOUNTS. THE ENGINE MUST REMAIN CENTERED IN THE ENGINE COMPARTMENT TO OBTAIN THIS MUCH LIFT. CAUTION: DO NOT RAISE ENGINE MORE THAN TWO INCHES. IF ENGINE IS RAISED MORE THAN TWO INCHES, DAMAGE WILL RESULT TO THE A/C MAIN AND AUXILIARY SUCTION LINES.**
7. Raise the engine and transmission assembly. Insert wood blocks to support engine in uppermost position.
8. Lower oil pan. Unbolt the oil pump and pick-up tube and lay in pan. Remove oil pan from vehicle.

Installation

1. Clean oil pan, pick-up tube, pump and gasket surfaces. Inspect gasket sealing surfaces for damage or distortion from overtightened bolts.
2. Position new gasket and seals to block. Position pan with pump to vehicle and install pump. Install oil pan and tighten attaching bolts to specifications. Install dipstick tube.
3. Position transmission jack, raise engine 1/4 inch, remove wood blocks, lower engine and remove jack. Install front insulator attaching nuts and tighten to specifications.
4. Install driveshaft. Connect manual linkage at transmission. Install muffler inlet pipe. Tighten nuts to Specification to Part 26-01, General Exhaust System Service. Install transmission filler tube. Connect radiator lower hose.
5. If so equipped, connect transmission cooler lines to radiator. Connect fuel line to pump. Install alternator splash shield. Lower vehicle on hoist.
6. Install radiator shroud and connect radiator upper hose. If so equipped, install power steering pump. Position power steering belt and adjust belt tension. Install bolt attaching dipstick tube to exhaust manifold.
7. Install oil filler tube and install air cleaner. Fill crankcase and cooling system (refer to Part 27-02, General Cooling System Service).
8. Connect battery. Start engine and check for leaks. Install engine cover. Close hood and door.

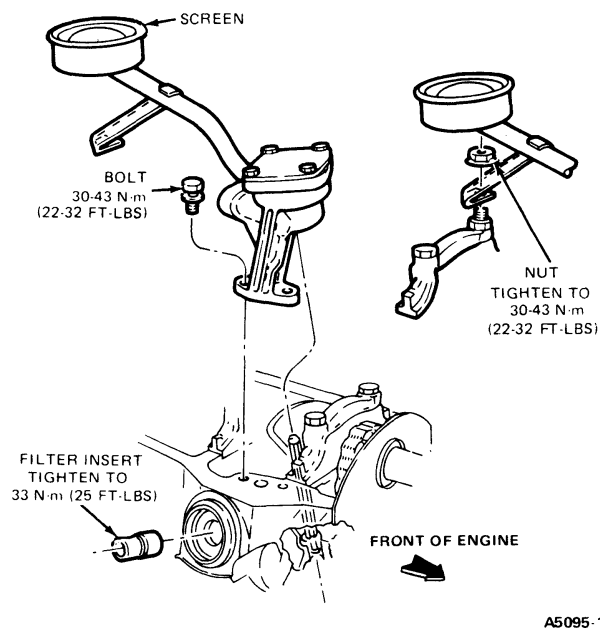
OIL PUMP

Removal

1. Remove the oil pan and related parts as outlined under Oil Pan Removal in this Part.
2. Remove the oil pump attaching bolts and remove the oil pump with pick up tube and screen, gasket and intermediate drive shaft.

Installation

1. Clean and install the oil pump inlet tube and screen assembly (Fig. 31).



A5095-1A

FIG. 31 Oil Pump and Inlet Tube Installed

2. Prime the oil pump by filling either the inlet or outlet port with engine oil. Rotate the pump shaft to distribute the oil within the pump body.
3. Position the intermediate drive shaft into the distributor socket. With the shaft firmly seated in the distributor socket, the stop on the shaft should touch the roof of the crankcase. Remove the shaft and position the stop as necessary.
4. With the stop properly positioned, insert the intermediate drive shaft into the oil pump. Install the pump and shaft as an assembly.

Do not attempt to force the pump into position if it will not seat readily. The drive shaft hex may be misaligned with the distributor shaft. To align, rotate the intermediate drive shaft into a new position.

Tighten the oil pump attaching screws to specification listed at the end of this Part. Be sure the oil pick up screen is parallel with the oil pan mounting surface.

5. Install the oil pan and related parts as outlined under Oil Pan Installation in this Part.

CRANKSHAFT REAR OIL SEAL

Replacement of a crankshaft rear oil seal because of oil leakage requires replacement of both the upper and lower seals. Refer to Crankshaft Rear Oil Seal Replacement in Part 21-01 for replacement procedures.

MAIN BEARING

Main bearing inserts are selective fits. Do not file or lap bearing caps or use bearing shims to obtain proper clearance.

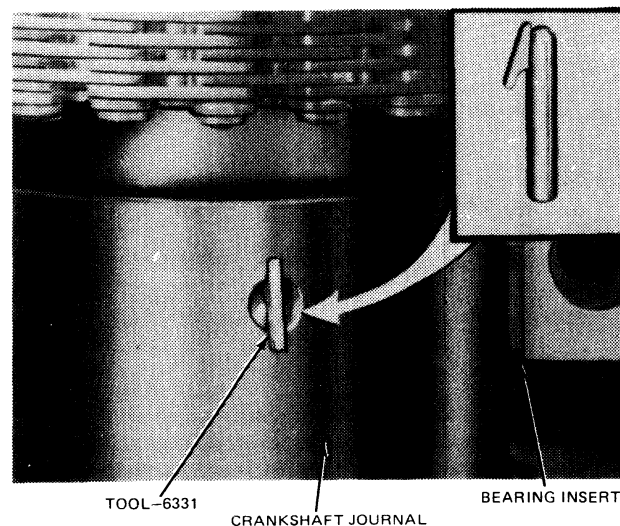
Selective fit bearings are available for service in standard size, 0.001 and 0.002 inch undersize. Undersize bearings (0.010, 0.020, 0.030 and 0.040 inch) which are not selective fit, are available for use on crankshaft journals that have been refinished.

Removal

1. Drain the crankcase. Remove the oil level dipstick. Remove the oil pan and related parts.
2. Remove the oil pump and inlet tube assembly.
3. Replace one bearing at a time, leaving the other bearings securely fastened.

Remove the main bearing cap to which new bearings are to be installed.

4. Insert the upper bearing removal tool (Tool 6331) or equivalent in the oil hole in the crankshaft (Fig. 32).



A2962-1B

FIG. 32 Removing or Installing Upper Main Bearing Insert

5. Rotate the crankshaft in the direction of the engine rotation to force the bearing out of the block.
6. If the rear main bearing is being replaced, remove and discard the rear oil seal from the bearing cap.

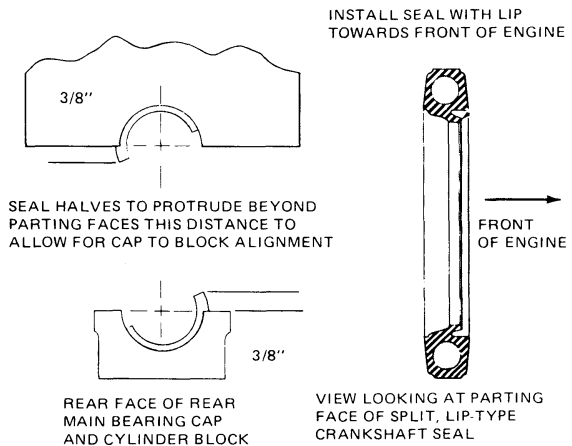
Loosen all main bearing bolts, thereby lowering the crankshaft slightly but not to exceed 1/32 inch. Remove the block half of the rear oil seal. Use a seal removal tool or install a small metal screw in one end of the seal, and pull on the screw to remove the seal. **Be careful not to burr the crankshaft seal rubbing surface.**

Installation

1. If the rear main bearing is being replaced, clean the rear oil seal groove in the block with a brush and solvent.

Carefully install the upper seal (split lip type) into its groove with the undercut side of the seal toward the FRONT of the engine (Fig. 33) by rotating it on the seal journal of the crankshaft until approximately 3/8 inch protrudes below the parting surface. **Be sure no rubber has been shaved from the outside diameter of the seal by the bottom edge of the groove. Tighten the bolts on main bearings 1, 2, 3 and 4, thereby**

raising the crankshaft to its original position. Tighten the bolts to specification listed at the end of this Part.



A2639-1D

FIG. 33 Installing Crankshaft Rear Oil Seal

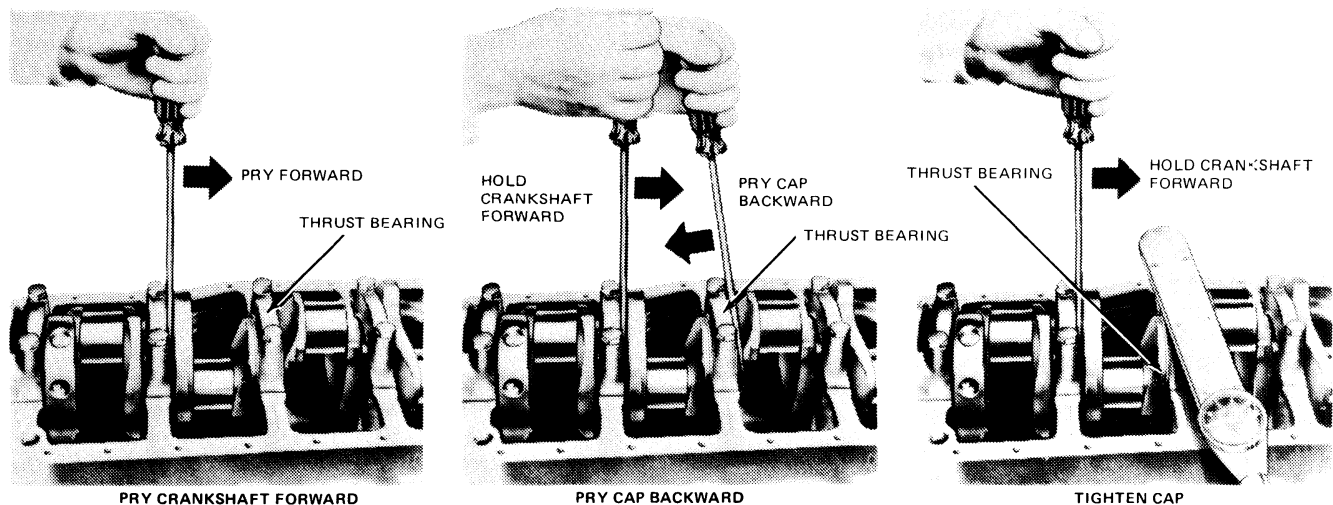
2. Clean the crankshaft journals. Inspect the journals and thrust faces (thrust bearing) for nicks, burrs or bearing pick-up that would cause premature bearing wear.
3. To install the upper main bearing, place the plain end of the bearing over the shaft on the locking tang side of the block and partially install the bearing so that Tool 6331 or equivalent can be inserted in the oil hole in the crankshaft (Fig. 32). With Tool 6331 or equivalent positioned in the oil hole in the crankshaft, rotate the crankshaft in the opposite direction of engine rotation until the bearing seats itself. Remove the tool.
4. Replace the cap bearing.
5. Select fit the bearing for proper clearance following procedures under Fitting Main and Connecting Rod Bearings in Part 21-01.
6. If the bearing is being replaced on journal number 1, 2 or 4, apply a light coat of engine oil to the

journal and bearings and install the bearing cap. Tighten the cap bolts to specification listed at the end of this Part.

7. If the rear main bearing is being replaced, clean the oil seal groove with a brush and solvent.
8. Install the lower seal in the rear main bearing cap with undercut side of seal toward the FRONT of the engine (Fig. 33), allow the seal to protrude approximately 3/8 inch above the parting surface to mate with the upper seal when the cap is installed.
9. Refer to Part 21-01 for special instructions in applying sealer to the rear main bearing cap. Lubricate the journal with engine oil and install the rear main bearing cap. Tighten the cap bolts to specification listed at the end of this Part.
10. If the thrust bearing cap (No. 3 main bearing) has been removed, install it as follows:

Lubricate the journal with engine oil and install the thrust bearing cap with the bolts finger tight. Pry the crankshaft forward against the thrust surface of the upper half of the bearing. Hold the crankshaft cap to the rear. This will align the thrust surfaces of both halves of the bearing. Retain the forward pressure on the crankshaft. Tighten the cap bolts to specification listed at the end of this Part (Fig. 34).

11. Clean the oil pump inlet tube screen. Prime the pump by filling the inlet opening with oil and rotate the pump shaft until oil emerges from the outlet opening. Install the oil pump and the inlet tube assembly.
12. Position the oil pan gaskets on the oil pan. Position the oil pan front seal on the cylinder front cover. Position the oil pan rear seal on the rear main bearing cap. Install the oil pan and related parts. Install the oil level dipstick.
13. Fill the crankcase with proper grade of oil. Start the engine and check for oil pressure. Operate the engine at fast idle and check for oil leaks.



A2879-2A

FIG. 34 Aligning Thrust Bearings

CONNECTING ROD BEARINGS

The connecting rod bearings are selective fit. Refer to procedures under Fitting Main and Connecting Rod Bearings in Part 21-01.

Removal

1. Drain the crankcase oil. Remove the oil level dipstick. Remove the oil pan and related parts.
2. Remove the oil pump and inlet tube assembly.
3. Turn the crankshaft until the connecting rod to which new bearings are to be fitted is down. Remove the connecting rod cap. Remove the bearing inserts from the rod and cap.

Installation

1. Be sure the bearing inserts and the bearing bore in the connecting rod and cap are clean. Foreign material under the inserts will distort the bearing and cause a failure.
2. Clean the crankshaft journal.
3. Install the bearing inserts in the connecting rod and cap with the tangs fitting in the slots provided.
4. Pull the connecting rod assembly down firmly on the crankshaft journal.
5. Select fit the bearing following procedures under Fitting Main and Connecting Rod Bearings in Part 21-01.
6. After the bearing has been fitted, clean and apply a light coat of engine oil to the journal and bearings. Install the connecting rod cap. Tighten to specification list at the end of this Part.
7. Clean the oil pump inlet tube screen. Prime by filling the inlet opening with oil and rotate the pump shaft until oil emerges from the outlet opening. Install the oil pump and the inlet tube assembly.
8. Position the oil pan gaskets on the oil pan. Position the oil pan front seal on the cylinder front cover plate. Position the oil pan rear seal on the rear main bearing cap. Install the oil pan and related parts. Install the oil level dipstick.
9. Fill the crankcase. Start the engine and check for oil pressure. Operate the engine at fast idle and check for oil leaks.

PISTONS AND CONNECTING RODS

Removal

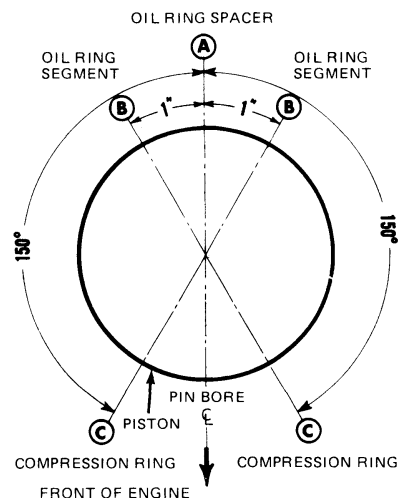
1. Drain the cooling system (refer to Part 27-02, General Cooling System Service) and the crankcase. Remove the intake manifold, cylinder heads, oil pan and oil pump, following the procedures in this Part.
2. Remove any ridges and/or deposits from the upper end of the cylinder bores as follows:

Turn the crankshaft until the piston to be removed is at the bottom of its travel and place a cloth on the piston head to collect the cuttings. Remove any ridge and/or deposits from the upper end of the cylinder bores. Remove the cylinder ridge with a ridge cutter. Follow the instructions furnished by the tool manufacturers. **Never cut into the ring travel area in excess of 1/32 inch when removing ridges.**

3. Make sure all connecting rod caps are marked so that they can be installed in their original positions.
4. Turn the crankshaft until the connecting rod being removed is down.
5. Remove the connecting rod nuts and cap.
6. Push the connecting rod and piston assembly out the top of the cylinder with the handle end of a hammer. **Avoid damage to the crankshaft journal or the cylinder wall when removing the piston and rod.**
7. Remove the bearing inserts from the connecting rod and cap.
8. Install the cap on the connecting rod from which it was removed.

Installation

1. If new piston rings are to be installed, remove the cylinder wall glaze. Follow the instructions of the tool manufacturer. Cylinder bores must be cleaned with a soap and water solution after deglazing or honing. Dry and oil the cylinder walls immediately after cleaning.
2. Oil the piston rings, pistons and cylinder walls with light engine oil. **Be sure to install the pistons in the same cylinders from which they were removed or to which they were fitted. The connecting rod and bearing caps are numbered from 1 to 4 in the right bank and from 5 to 8 in the left bank, beginning at the front of the engine. The numbers on the connecting rod and bearing cap must be on the same side when installed in the cylinder bore. If a connecting rod is ever transposed from one block or cylinder to another, new bearings should be fitted and the connecting rod should be numbered to correspond with the new cylinder number.**
3. Make sure the ring gaps (oil ring spacer-A, oil ring-B, compression ring-C) are properly spaced around the circumference of the piston (Fig. 35).



A2811-1A

FIG. 35 Piston Ring Spacing

4. Install a piston ring compressor on the piston and push the piston in with a hammer handle until it is slightly below the top of the cylinder (Fig. 36). Be

sure to guide the connecting rods to avoid damaging the crankshaft journals. **Install the piston with the arrow on the piston head toward the front of the engine (Fig. 37).**

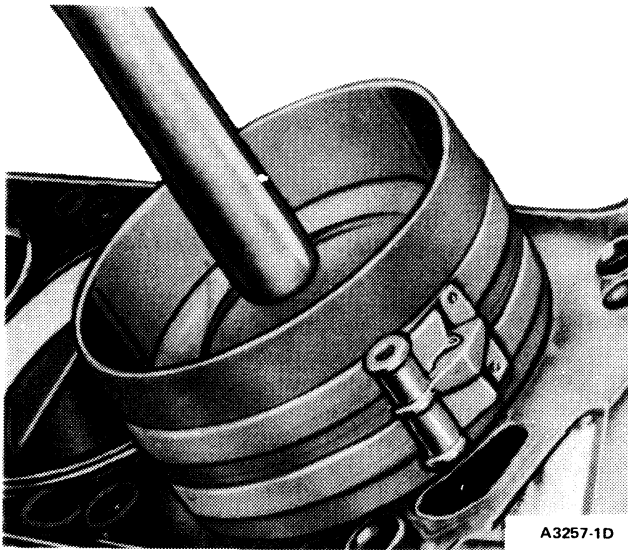


FIG. 36 Installing Piston

the connecting rods on each crankshaft journal (Fig. 38).

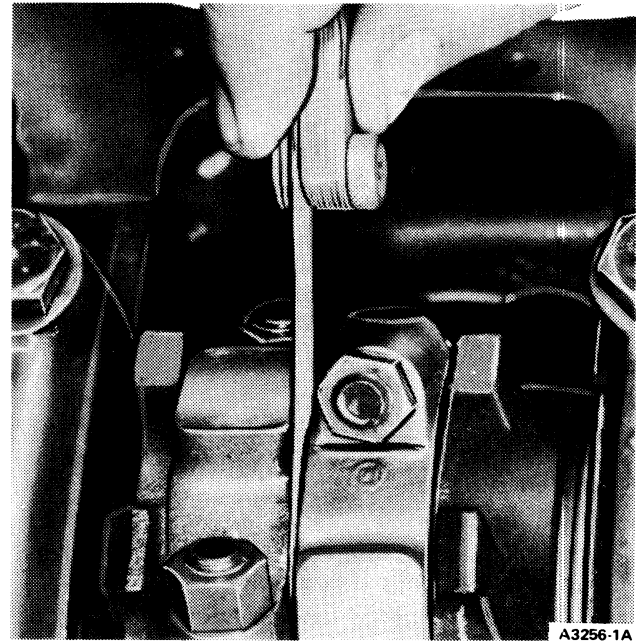


FIG. 38 Checking Connecting Rod Side Clearance

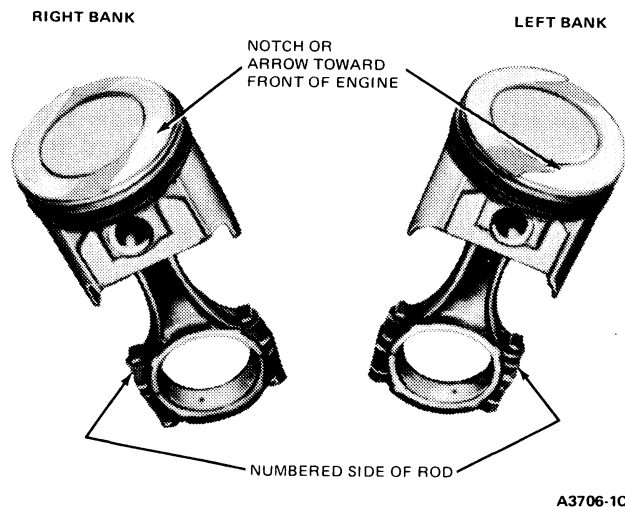


FIG. 37 Correct Piston and Rod Positions

5. Check the clearance of each bearing following the procedure under Fitting Main and Connecting Rod Bearings in Part 21-01.
6. After the bearings have been fitted, apply a light coat of engine oil to the journals and bearings.
7. Turn the crankshaft throw to the bottom of its stroke. Push the piston all the way down until the connecting rod bearing seats on the crankshaft journal.
8. Install the connecting rod cap and bearing. Tighten the nuts to specification listed at the end of this Part.
9. After the piston and connecting rod assemblies have been installed, check the side clearance (refer to specifications at the end of this Part) between

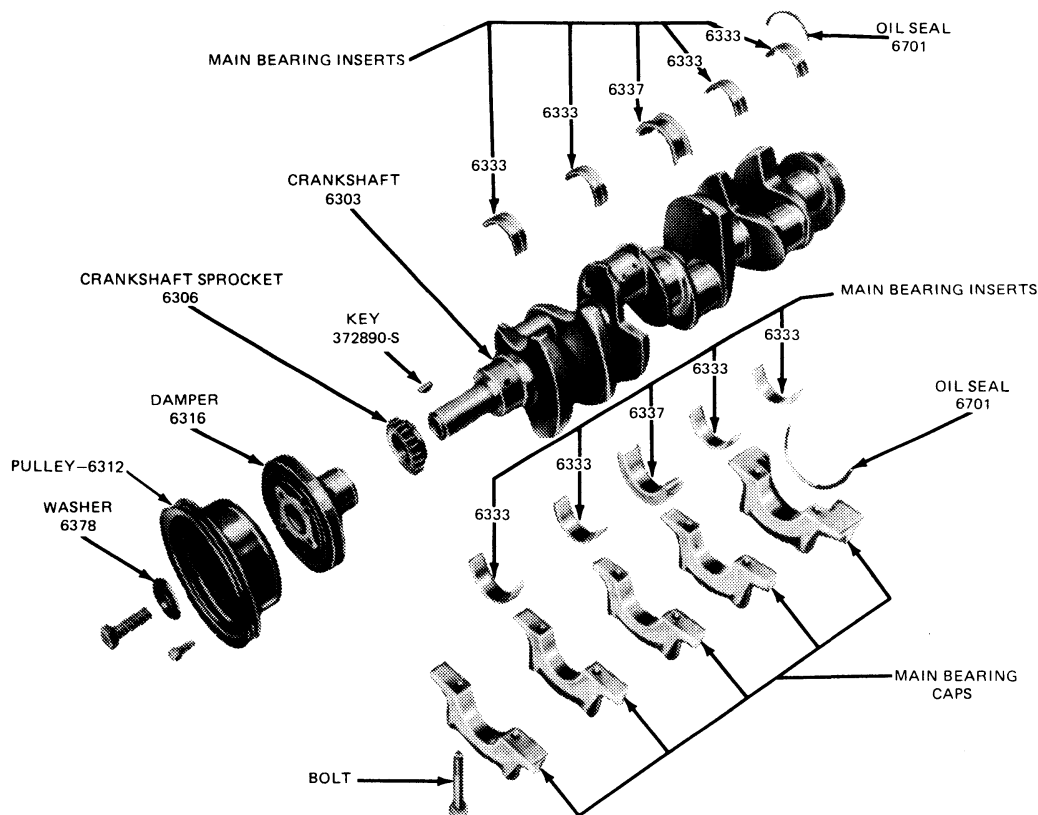
10. Disassemble, clean and assemble the oil pump. Clean the oil pump inlet tube screen and the oil pan and block gasket surfaces.
11. Prime the oil pump by filling either the inlet port or outlet port with engine oil and rotating the pump shaft to distribute the oil within the housing. Install the oil pump and the oil pan.
12. Install the cylinder heads following procedures under Cylinder Head Installation in this Part.
13. Install the intake manifold following procedures under Intake Manifold Installation in this Part.
14. Fill and bleed the cooling system (refer to Part 27-02, General Cooling System Service). Fill the crankcase with the proper grade and quantity of engine oil.
15. Start the engine and check and adjust the ignition timing to settings listed on the engine specifications decal. Connect the distributor vacuum hoses at the distributor.
16. Operate the engine at fast idle until it reaches normal operating temperature and check for oil and coolant leaks. When the engine temperature has stabilized adjust the engine idle speed and idle fuel mixture to specifications on engine decal.
17. Install the air cleaner and intake duct assembly.

CRANKSHAFT

The crankshaft and related parts are shown in Fig. 39.

Removal

1. With engine removed from vehicle and placed on a work stand, disconnect the spark plug wires at the spark plugs using Tool T68P-6666-A or equivalent, and remove the wires from the ignition harness brackets on the valve rocker arm covers.



A3266-2E

FIG. 39 Crankshaft and Related Parts

Disconnect the coil-to-distributor cap and spark plug wire assembly. Remove the spark plugs to allow easy rotation of the crankshaft.

2. Disconnect the fuel pump outlet line at the pump. Remove the fuel pump from the cylinder block. Remove the alternator and mounting brackets.
3. Remove the crankshaft pulley from the crankshaft vibration damper. Remove the cap screw and washer from the end of the crankshaft. Install the puller on the crankshaft vibration damper (Fig. 22), and remove the damper.
4. Remove the timing pointer. Remove the water pump and cylinder front cover plate as an assembly. Discard the gasket.
5. Check the timing chain deflection (Refer to Part 21-01). Remove the camshaft sprocket cap screw, washer and two piece fuel pump eccentric. Slide both sprockets and the timing chain forward and remove them as an assembly (Fig. 24).
6. Invert the engine on the work stand. Remove the flywheel and engine rear cover plate. Remove the oil pan and gasket. Remove the oil pump.
7. Make sure all bearing caps (main and connecting rod) are marked so that they can be installed in their original locations.

Turn the crankshaft until the connecting rod from which the cap is being removed is down, and remove the bearing cap. Push the connecting rod and piston assembly up into the cylinder. Repeat this procedure until all the connecting rod bearing caps are removed.

8. Remove the main bearing caps.

9. Carefully lift the crankshaft out of the block so that the thrust bearing surfaces are not damaged. **Handle the crankshaft with care to avoid possible fracture or damage to the finished surfaces.** To refinish journals, dress minor imperfections, etc., refer to Part 21-01.

Installation

1. Remove the rear journal oil seal from the block and rear main bearing cap.
2. Remove the main bearing inserts from the block and bearing caps.
3. Clean the rear journal oil seal groove and the mating surfaces of the block and rear main bearing cap.
4. Remove the connecting rod bearing inserts from the connecting rods and caps.
5. If the crankshaft main bearing journals have been refinished to a definite undersize, install the correct undersize bearings. Be sure the bearing inserts and bearing bores are clean. Foreign material under the inserts will distort the bearing and cause a failure.
6. Place the upper main bearing inserts in position in the bores with the tang fitting in the slot provided.
7. Install the lower main bearing inserts in the bearing caps.
8. Dip the lip seal halves in clean engine oil. Install the lip seals in the bearing cap and block with the undercut side of the seal toward the FRONT of the engine as shown in Fig. 33.
9. Carefully lower the crankshaft into place. **Be careful not to damage the bearing surface.**

10. Check the clearance of each main bearing following the procedure under Fitting Main and Connecting Rod Bearings in Part 21-01.
11. After the bearings have been fitted, apply sealer to the rear main bearing cap, following the instructions given in Part 21-01 for use of silicone rubber sealer in this area.
12. Apply heavy engine oil SE to the journals and bearings.
13. Install the rear main bearing cap with the rear surface flush or slightly ahead of the rear of the cylinder block. Install all bearing caps, except the thrust bearing cap (No. 3 bearing). **Be sure that the main bearing caps are installed in their original locations.**
Tighten the bearing cap bolts to specification listed at the end of this Part.
14. Install the thrust bearing cap with the bolts finger tight.
15. Pry the crankshaft forward against the thrust surface of the upper half of the bearing (Fig. 34).
16. Hold the crankshaft forward and pry the thrust bearing cap to the rear. This will align the thrust surfaces of both halves of the bearing.
17. Retain the forward pressure on the crankshaft. Tighten the cap bolts to specification listed at the end of this Part.
18. Force the crankshaft toward the rear of the engine.
19. Check the crankshaft end play (Refer to Part 21-01).
20. Install the timing chain and sprockets, cylinder front cover plate and fuel pump, following Steps 1 thru 8 under Cylinder Front Cover Plate and Timing Chain Installation in this Part.
21. Install the engine rear cover plate onto the alignment dowels at the rear of the cylinder block.
22. Coat the threads of the flywheel attaching bolts with oil-resistant sealer. Position the flywheel on the crankshaft flange. Install and tighten the bolts to specification listed at the end of this Part.
23. Install new bearing inserts in the connecting rods and caps. Check the clearance of each bearing following the procedures under Fitting Main and Connecting Rod Bearings in Part 21-01.
24. After the connecting rod bearings have been fitted, apply a light coat of engine oil to the journals and bearings.
25. Turn the crankshaft throw to the bottom of its stroke. Push the piston all the way down until the rod bearing seats on the crankshaft journal.
26. Install the connecting rod cap. Tighten the nuts to specification listed at the end of this Part.
27. After the piston and connecting rod assemblies have been installed, check the side clearance (refer to Specifications at the end of this Part) between the connecting rods on each connecting rod crankshaft journal (Fig. 38).
28. Clean the oil pan, oil pump and oil pump screen. Prime the oil pump by filling either the inlet or outlet port with engine oil and rotating the pump shaft to distribute oil within the housing. Install the oil

pump and oil pan by following the procedures under Oil Pan and Oil Pump Installation in this Part.

29. Install the front oil seal, vibration damper and crankshaft pulley, following Steps 8 thru 13 under Cylinder Front Cover Plate and Timing Chain Installation, in this Part.
30. Install the spark plugs, distributor cap and spark plug wires. Connect the spark plug wires and high tension lead.
31. Install the engine in the vehicle.

CAMSHAFT BEARINGS

Camshaft bearings are available prefinished to size for standard and 0.015 inch undersize journal diameters. The bearings are not interchangeable from one bore to another.

Removal

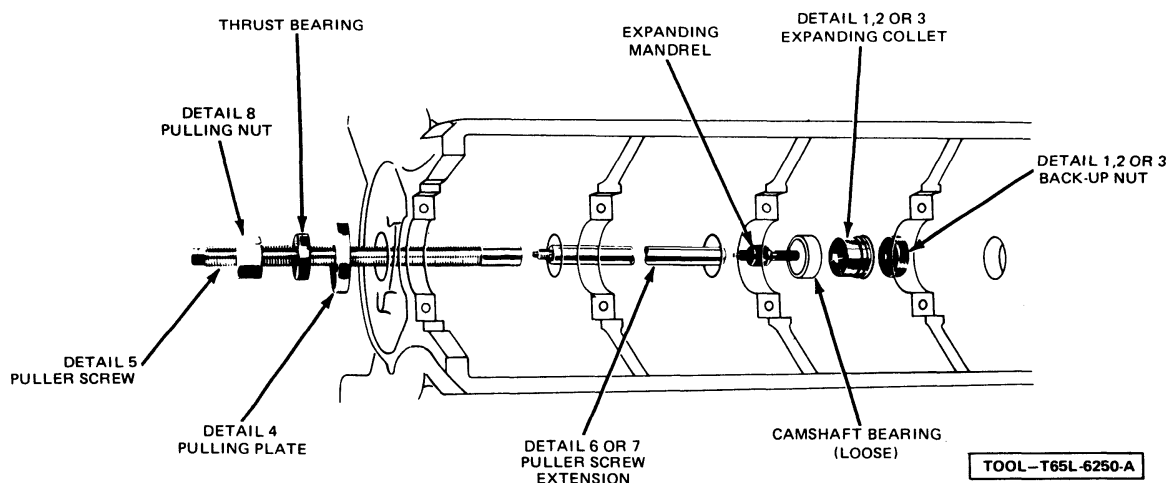
1. Remove the engine from the vehicle. Remove the camshaft, flywheel and crankshaft, following the appropriate procedures in this part. Push the pistons to the top of the cylinders.
2. Remove the camshaft rear bearing bore plug. Remove the camshaft bearings (Fig. 40).
3. Select the proper size expanding collet and back-up nut and assemble on the expanding mandrel. With the expanding collet collapsed, install the collet assembly in the camshaft bearing, and tighten the back-up nut on the expanding mandrel until the collet fits the camshaft bearing.
4. Assemble the puller screw and extension (if necessary) as shown and install on the expanding mandrel. Wrap a cloth around the threads of the puller screw to protect the front bearing or journal. Tighten the pulling nut against the thrust bearing and pulling plate to remove the camshaft bearing. Be sure to hold a wrench on the end of the puller screw to prevent it from turning.
5. Repeat the procedure for each bearing. To remove the front bearing, install the puller screw from the rear of the cylinder block.

Installation

1. Position the new bearings at the bearing bores with the oil holes aligned, and press them in place with the tool shown in Fig. 40. Be sure to center the pulling plate and puller screw to avoid damage to the bearing. **Failure to use the correct expanding collet can cause severe bearing damage. Be sure the front bearing is installed the specified distance below the front face of the cylinder block (Fig. 41).**
2. Install the core plug as detailed in Part 21-01.
3. Install the camshaft, crankshaft, flywheel and related parts, following the appropriate procedures in this Part except do not check connecting and main bearing clearances as a part of Camshaft Bearing Replacement. Install the engine in the vehicle.

CLUTCH PILOT BEARINGS

A needle roller bearing and adaptor assembly is used as a clutch pilot bearing on E-150—E-350, F-100—F-



A2813-2A

FIG. 40 Camshaft Bearing Replacement

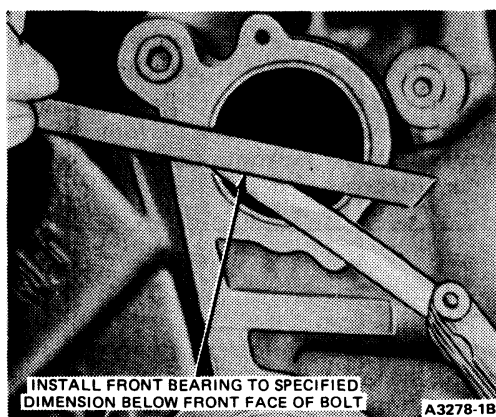


FIG. 41 Camshaft Front Bearing Measurement

350 and Bronco vehicles (Fig. 42). It is inserted directly into the engine crankshaft. The bearing and adaptor comprising an assembly that cannot be serviced separately. The needle bearing clutch pilot can only be installed with the seal end of the bearing facing the transmission. The bearing and seal are pregreased and do not require additional lubrication. A new bearing must be installed whenever a bearing is removed.

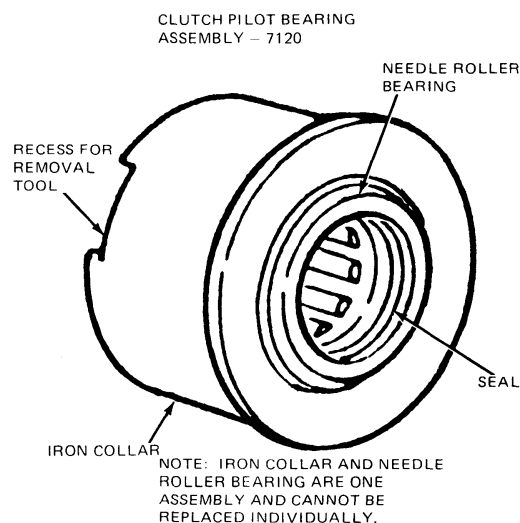
Removal

1. Remove the transmission, clutch pressure plate, and disc following the procedures in Group 16.
2. Using Tools T59L-100B and T58L-101-A or equivalent, remove the pilot bearing (Fig. 43).

Installation

1. Using Tool—7600-H or equivalent install the pilot bearing with the seal facing the transmission (Fig. 44) so that the adaptor is not cocked.
2. Install the clutch pressure plate, disc, and transmission following the procedure in Group 16.

Note: Care must be taken not to damage the bearing during transmission installation while the transmission input shaft is being inserted into the bearing.



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FIG. 42 Needle Pilot Bearing Assembly

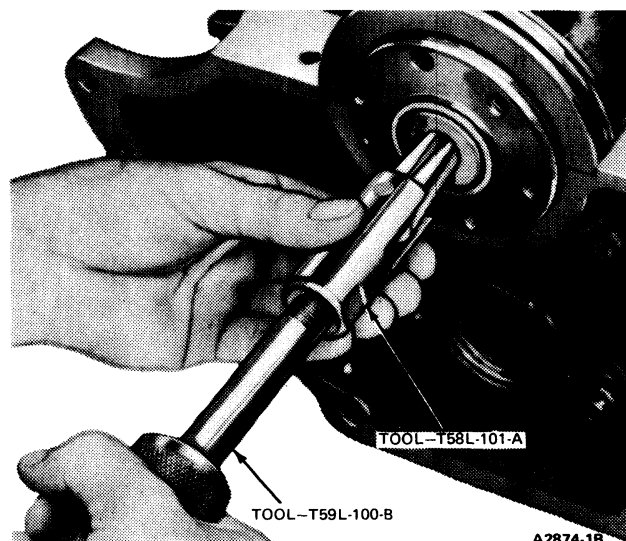


FIG. 43 Removing Clutch Pilot Needle Bearing Assembly

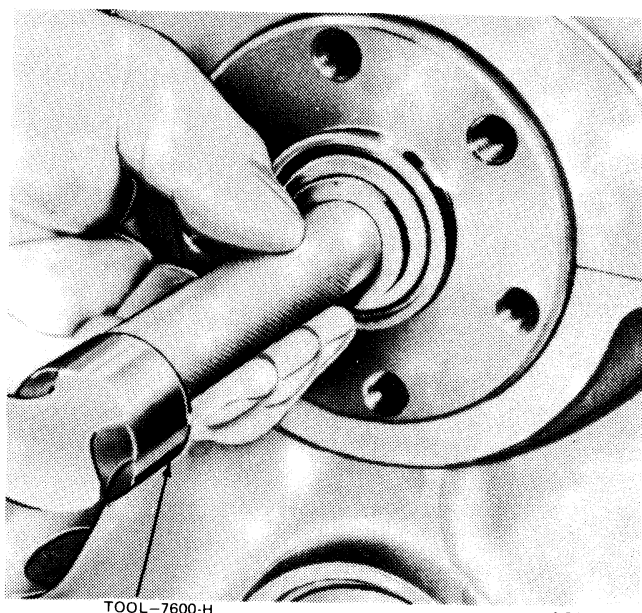


FIG. 44 Installing Clutch Pilot Bearing Assembly

OIL FILTER

The oil filter assembly is shown in Fig. 45.

Removal

Place a drip pan under the filter. Unscrew the filter from the adapter fitting and clean the adapter recess.

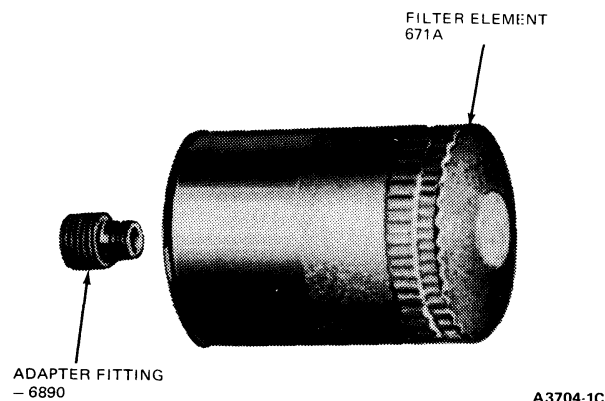


FIG. 45 Oil Filter Installation

Installation

1. Coat the gasket on a new filter with oil. Place the new filter in position on the adapter fitting. Hand tighten the filter until the gasket contacts the adapter face, and then advance it 1/2 turn.
2. Fill the crankcase to the required level with the proper type and grade of lubricant.
3. Operate the engine at fast idle, and check for oil leaks. If oil leaks are evident, perform the necessary repairs to correct leakage. Check the oil level and fill the crankcase if necessary.

DISASSEMBLY AND ASSEMBLY

When installing nuts or bolts that must be tightened (refer to torque specification at the end of this Part), oil the threads with light weight engine oil. **Do not oil threads that require oil-resistant or water-resistant sealer.** Refer to Part 21-01, for cleaning and inspection procedures.

CYLINDER HEAD

Disassembly

1. Remove the exhaust manifolds, the spark plugs and spark plug wire shields.
2. Clean the carbon out of the cylinder head combustion chambers before removing the valves.
3. Compress the valve springs (Fig. 46). Remove the spring retainer locks and release the spring.

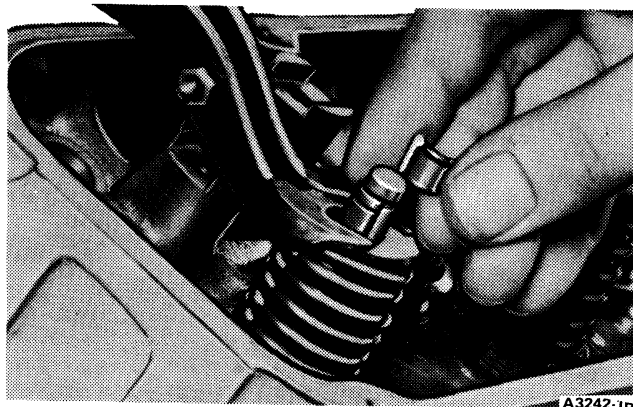


FIG. 46 Compressing Valve Spring

4. Remove the spring retainer, spring and stem seal. Discard the valve stem seals. **Remove any burrs from the valve stem with Tool T70P-6505-A as shown in Fig. 47 to prevent damage to the valve guide bore. Remove the valve. Identify all valve parts.**

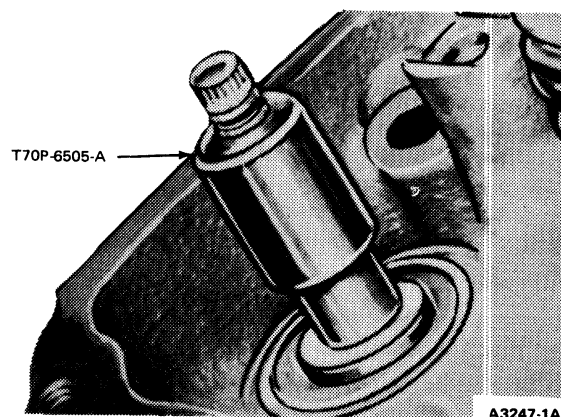


FIG. 47 Removing Valve Stem Burrs

5. Clean, inspect and repair the cylinder head as required, or transfer all usable parts to a new cylinder head.

Assembly

All valves, valve stems and valve guides are to be lubricated with heavy engine oil SE. The valve tips are to have Lubriplate or equivalent applied. The lubricant is to be applied before installation.

1. Clean the spring retainer lock grooves on the valves to remove any loose material left by the valve stem deburring tool.
2. Lubricate the valve guide and valve stem with heavy engine oil SE.
3. Install each valve (Fig. 48), in the port from which it was removed or to which it was fitted. Install a new stem seal on the valve use a 5/8 inch deep wall socket and a light hammer or mallet to seat the seal on the valve stem.

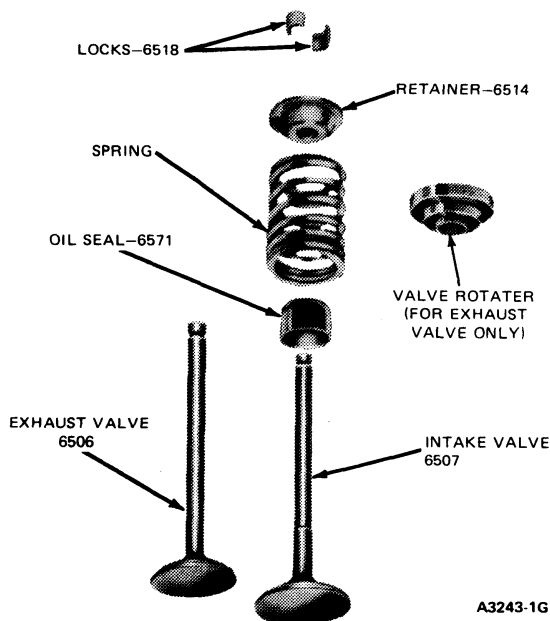


FIG. 48 Valve and Related Parts

4. Install the valve spring over the valve, and then install the spring retainer. Compress the spring and install the retainer locks (Fig. 48).
5. Measure the assembled height of the valve spring from the surface of the cylinder head spring pad to the underside of the spring retainer with dividers (Fig. 49). Check the dividers against a scale. If the assembled height is greater than specification, install the necessary 0.030 inch thick spacer(s) between the cylinder head spring pad and the valve spring to bring the assembled height to the recommended height. **Do not install the spacers unless necessary. Use of spacers in excess of recommendations will result in overstressing the valve springs and over-loading the camshaft lobes which could lead to spring breakage and/or worn camshaft lobes.**
6. Install the exhaust manifolds and the spark plugs.

VALVE TAPPET

The internal parts of each hydraulic valve tappet assembly are matched sets. Do not intermix the parts. Keep the assemblies intact until they are to be cleaned.

Valve tappets should always be tested after assembly; refer to the procedures covered in Part 21-01 for cleaning, inspection and testing.

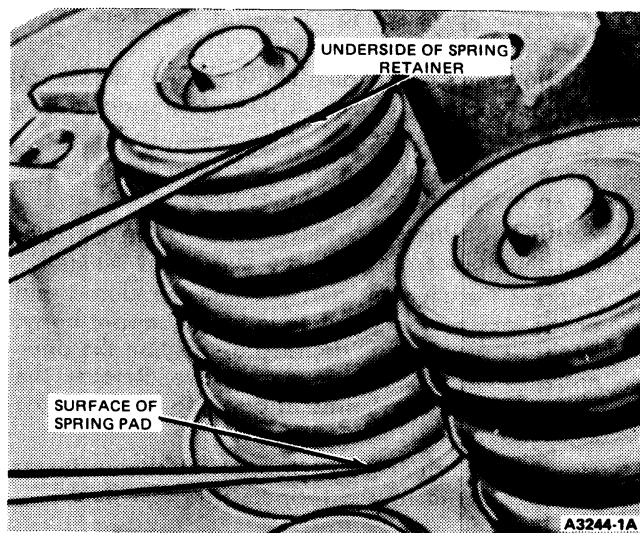


FIG. 49 Valve Spring Assembled Height

Disassembly

Disassemble and assemble each tappet separately. Identify the tappet assemblies so they can be installed in their original bores (Fig. 50).

1. Grasp the lock ring with needle nose pliers to release it from the groove. It may be necessary to depress the plunger to fully release lock ring.
2. Remove the push rod cup, metering valve (disc), plunger and spring.
3. Remove the plunger assembly and the plunger spring. Carefully remove the plunger spring, check valve retainer and spring, and check valve disc from the plunger.

Refer to Part 21-01 for cleaning and inspection procedures.

Assembly

Hydraulic tappet assembly is shown in Fig. 50.

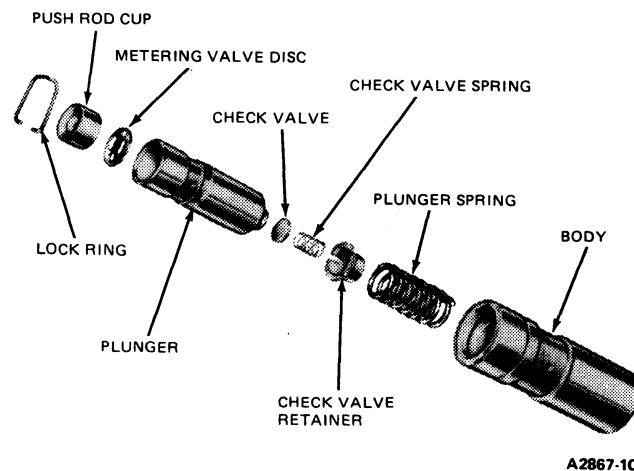


FIG. 50 Hydraulic Valve Tappet Assembly

1. Place the plunger upside down on a clean work bench.
2. Place the check valve (disc or ball check) in position over the oil hole on the bottom of the plunger. Set

the check valve spring on top of the check valve (disc or ball check).

- Position the check valve retainer over the check valve and spring and push the retainer down into place on the plunger.
- Place the plunger spring, and then the plunger (open end up) into the tappet body.
- Position the metering valve (disc) in the plunger, and then place the push rod cup in the plunger.
- Depress the plunger, and position the closed end of the lock ring in the groove of the tappet body. With the plunger still depressed, position the open ends of the lock ring in the groove. Release the plunger, and then depress it again to fully seat the lock ring.
- Use the hydraulic valve tappet leakdown tester (Part 21-01) to fill the tappets with test fluid.

OIL PUMP

The oil pump is not serviced. Replace if assembly becomes worn or damaged.

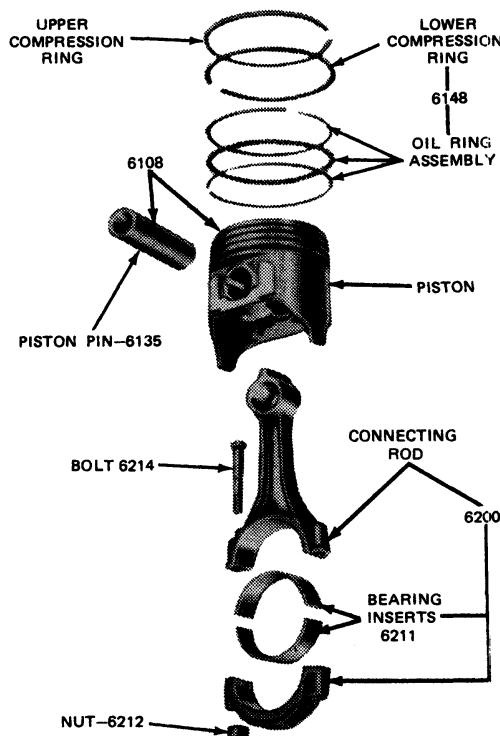
PISTON AND CONNECTING ROD

Disassembly

- Remove the bearing inserts from the connecting rod and cap.
- Mark the pistons to assure assembly with the same rod and installation in the same cylinders from which they were removed.
- Remove the piston rings. Using an arbor press and the tool shown in Fig. 51, press the piston pin from the piston and connecting rod.

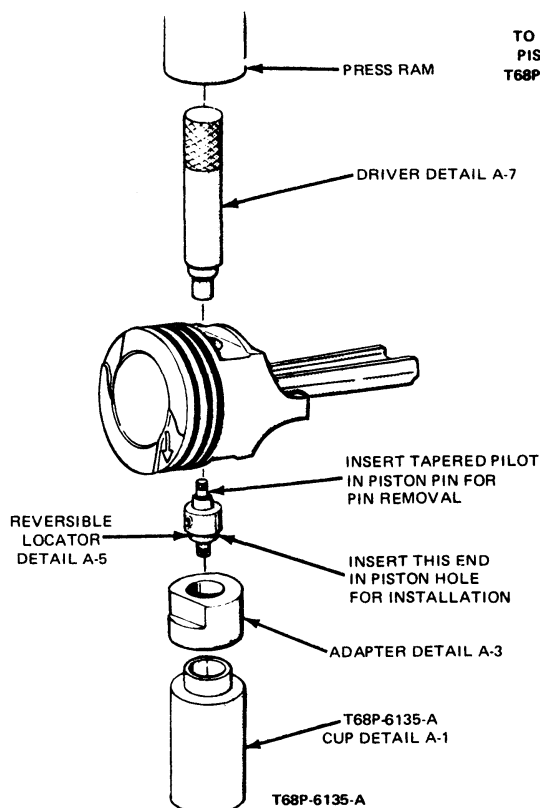
Assembly

The piston connecting rod and related parts are shown in Fig. 52. **Check the fit of a new piston in the cylinder bore before assembling the piston and piston pin to the connecting rod.**

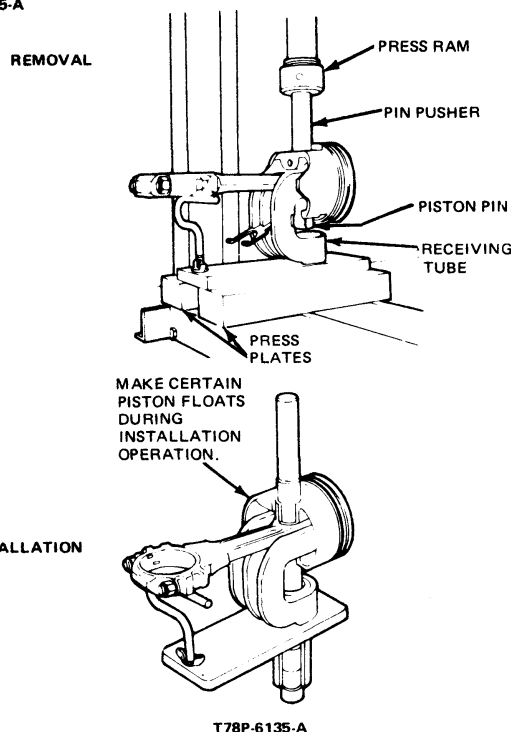


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FIG. 52 Piston, Connecting Rod and Related Parts



TO REMOVE OR INSTALL
PISTON PIN USE EITHER
T68P-6135-A OR T78P-6135-A



MAKE CERTAIN
PISTON FLOATS
DURING
INSTALLATION
OPERATION.

INSTALLATION

T78P-6135-A

A4871-2A

FIG. 51 Removing or Installing Piston Pin

The piston pin bore of a connecting rod and the diameter of the piston pin must be within specification listed at the end of this Part.

1. Apply a light coat of engine oil to all parts. Assemble the piston to the connecting rod with the cylinder number side of the connecting rod and the arrow on the piston positioned as shown in Fig. 37. On replacement connecting rods, install the large-chamfered side of the connecting rod bearing bore towards the crankshaft cheek; facing towards front of engine on right bank rods, and facing towards rear of engine on left bank rods.
2. Start the piston pin in the piston and connecting rod (this may require a very light tap with a mallet). Using an arbor press and the tool shown in Fig. 51, press the piston pin through the piston and connecting rod until the pin is centered in the piston.
3. Check the end gap of all piston rings (Part 21-01). It must be within specification listed at the end of this Part. Follow the instructions contained on the piston ring package and install the piston rings.
4. Check the ring side clearance (refer to specification at the end of this Part), of the compression rings with a feeler gauge inserted between the ring and its lower land (Part 21-01). The gauge should slide freely around the entire ring circumference without binding. Any wear that occurs will form a step at the inner portion of the lower land. **If the lower lands have high steps, the piston should be replaced.**
5. Be sure the bearing inserts, the bearing bore and the mating surfaces on the connecting rod and cap are clean. Foreign material under the inserts will distort the bearing and cause a failure. Install the bearing inserts in the connecting rod and cap with the tangs fitting in the slots provided.

CYLINDER ASSEMBLY—6009

Disassembly

1. Remove the intake manifold, cylinder heads, front cover (with water pump attached), thermostat and housing, oil pressure and temperature sending units, fuel pump, flywheel, oil pan, oil pump and associated attaching parts from the old engine, using the procedures given in the Removal and Installation section of this Part.
2. Remove the dipstick tube, oil filter adapter and fuel pump retaining stud from the old block. Remove

fasteners and components not received with the replacement cylinder block.

Assembly

1. Clean the gasket and seal surfaces of all parts and assemblies.
2. Position the replacement cylinder assembly in a work stand. Install the cylinder block drain plugs, cylinder head locating dowels, front and rear cover plate locating dowels, dipstick tube, oil filter adapter and fuel pump retaining stud.
3. Transfer all serviceable parts removed from the old cylinder assembly, following the installation procedures given in the Removal and Installation section of this Part.
4. Check all assembly clearances and correct as necessary.

CYLINDER BLOCK—6010

Before replacing a cylinder block, determine if it is repairable. If so, make the necessary repairs, following the procedures given in Part 21-01.

Disassembly

1. Disassemble the engine completely, following the various procedures given in the Removal and Installation section of this Part. Remember to remove any ridge or carbon deposit from the upper end of the cylinder bores before removing pistons.
2. Remove the temperature and oil pressure sending units from the old block, dipstick tube, oil filter adapter and fuel pump retaining stud.
3. Remove the old cylinder block from the work stand.

Assembly

1. Install the replacement cylinder block on the work stand. Install the temperature and oil pressure sending units, dipstick tube, oil filter adapter and fuel pump retaining stud. Remove fasteners and components not received with the replacement cylinder block.
2. Clean all the gasket and seal surfaces of all parts and assemblies before installing on the replacement cylinder block.
3. Transfer all serviceable parts removed from the old cylinder block to the replacement unit, using the procedures given in the Removal and Installation section of this Part.
4. Check all assembly clearances and correct as necessary.

SPECIFICATIONS

GENERAL SPECIFICATIONS

Engine	Bore and Stroke	Firing Order	Oil Pressure Hot @ 2000 RPM kPa (PSI)	Engine Type and Number of Cylinders	Belt Tension — Lb. ①
5.8L (351 CID) M V-8	4.00 x 3.50	13726548	345-517 (50-75)	O.H.V. V-8	—
6.6L (400 CID) V-8	4.00 x 4.00	13726548	345-517 (50-75)		

①

Belt Size	Newly Installed ②	Used less than 10 min.	Used over 10 min.
All except ¼"	534-711N (120-160 lbs)	400-711N (90-160 lbs) ③	334-533N (75-120 lbs) ④
¼" Only	223-355N (50-80 lbs)	178-355N (40-80 lbs) ③	178-266N (40-60 lbs) ③

② Tension measured immediately after belt is installed and before it is stretched or seats in pulley grooves.

③ If less than 400N (90 lbs), readjust to 400-534N (90-120 lbs).

④ If less than 178N (40 lbs), readjust to 178-266N (40-60 lbs).

⑤ If less than 334N (75 lbs), readjust to 400-534N (90-120 lbs).

CYLINDER HEAD

Engine	Combustion Chamber Volume C.C. ①	Valve Guide Bore Diameter		Valve Seat Width ①		Valve Seat Runout TIR Maximum	Valve Arrangement Front to Rear	Gasket Surface Flatness ②
		Intake	Exhaust	Intake	Exhaust			
5.8L (351 CID) M V-8	76.9-	.3433-	.3433-	.060-	.070-	.002	RT I-E-I-E-I-E-I-E	.003 in.
6.6L (400 CID) V-8	79.9	.3443	.3443	.080	.090		LT E-I-E-I-E-I-E-I	any 6 in. .006 overall

① Valve seat angle — 45°

② Gasket surface finish — RMS 60-150

③ Compression pressure (PSI) of the lowest cylinder must be at least 75½ of the highest to be within specification.

VALVE ROCKER ARM SHAFT, PUSH RODS AND TAPPETS

Engine	Rocker Arm Lift Ratio to 1	Push Rod Runout TIR Maximum	Valve Tappet or Lifter			Collapsed Tappet Gap Clearance	
			Standard Diameter	Clearance to Bore ①	Hydraulic Lifter Leakdown Rate ②	Allowable	Desired
5.8L (351 CID) M V-8	1.73	.015	.8740-.8745	.0007-	10 to 50 seconds for 1/16 travel	.100	.125
6.6L (400 CID) V-8				.0027		.200	.175

① Service limit .005.

② Time required for plunger to leakdown .0625 in. under load of 50 lbs. using leakdown fluid in tappet.

VALVE SPRINGS

Engine	Valve Spring Compression Pressure Lbs. @ Specified Height		Valve Spring Free Length (Approximate)		Valve Spring Assembled Height		Valve Spring Out Of Square
	Intake ①	Exhaust	Intake	Exhaust	Intake	Exhaust	Maximum
5.8L (351 CID) M V-8	76-84 @ 1.82	79-87 @ 1.68	2.06	1.93	1-13/16 — 1-27/32	1-11/16 — 1-23/32	5/64 (.078)
	215-237 @ 1.39	215-237 @ 1.39					
6.6L (400 CID) V-8	76-84 @ 1.82	79-87 @ 1.68					
	215-237 @ 1.39	215-237 @ 1.39					

① Service limit — 10½ loss of pressure.

VALVES

Engine	Valve Stem to Guide Clearance ①		Valve Head Diameter ②		Valve Face Runout TIR
	Intake	Exhaust	Intake	Exhaust	Maximum
5.8L (351 CID) M V-8	.0010-.0027	.0015-.0032	2.032-2.050	1.649	.002
6.6L (400 CID) V-8				1.659	

① Service clearance — .005 max.

② Valve face angle — 44°.

VALVES (Continued)

Engine	Valve Stem Diameter					
	Standard		.015 Oversize		.030 Oversize	
	Intake	Exhaust	Intake	Exhaust	Intake	Exhaust
5.8L (351 CID) M-V-8	.3416-	.3411-	.3566-	.3561-	.3716-	.3711-
6.6L (400 CID) V-8	.3423	.3418	.3573	.3568	.3723	.3718

CAMSHAFT

Engine	Lobe Lift ①		Camshaft End Play		Camshaft Journal To Bearing Clearance ②
	Intake	Exhaust	End Play	Wear Limit	
5.8L (351 CID) M-V-8	.250	.250	.001-.006	.009	.001-.003
6.6L (400 CID) V-8	.250	.250	.001-.006	.009	.001-.003

① Maximum allowable lift loss — .005.

② Service limit — .006.

CAMSHAFT

Engine	Camshaft Journal Diameter — Standard ①					Camshaft Bearing Inside Diameter					Camshaft Front Bearing Location ②	Timing Chain Deflection Inches Maximum
	No. 1	No. 2	No. 3	No. 4	No. 5	No. 1	No. 2	No. 3	No. 4	No. 5		
5.8L (351 CID) M-V-8	2.1238-	2.0655-	2.0505-	2.0355-	2.0205-	2.1258-	2.0675-	2.0525-	2.0375-	2.0225-	.040-	.500
6.6L (400 CID) V-8	2.1248	2.0665	2.0515	2.0365	2.0215	2.1268	2.0685	2.0535	2.0385	2.0235	.060	

① Camshaft journal runout — .005 TIR maximum.

② Distance in inches that front edge of the bearing is installed below the front face of the cylinder block.

CYLINDER BLOCK

Engine	Cylinder Bore Diameter ①	Main Bearing Bore Diameter	Distributor Shaft Bearing Bore Diameter	Head Gasket Surface Flatness	Head Gasket Surface Finish	Tappet Bore Diameter
5.8L (351 CID) M-V-8	4.0000-	3.1922-	.5160-	.003 in any 6 in.	RMS	.8752-
6.6L (400 CID) V-8	4.0048	3.1930	.5175	.006 overall	60-150	.8767

① Maximum out-of-round — .0015, service limit — .005, maximum taper service limit — .010, cylinder bore surface finish RMS 18-38, bore taper service limit — .010.

CRANKSHAFT AND FLYWHEEL

Engine	Main Bearing Journal Diameter ①	Main Bearing Journal Runout TIR Maximum ②	Main Bearing Thrust Face Runout TIR Maximum	Main Bearing Journal Taper Maximum Per Inch	Thrust Bearing Journal Length	Main and Rod Bearing Journal Finish RMS Maximum	Main Bearing Thrust Face Finish RMS Maximum
5.8L(351CID)M-V-8	2.9994-3.0002	.002	.001	.0005	1.137-1.139	12	25 Front — 20 Rear
6.6L (400 CID) V-8							

① Maximum out-of-round — .0006.

② Service limit — .005

CRANKSHAFT AND FLYWHEEL (Continued)

Engine	Connecting Rod Journal Diameter ^①	Connecting Rod Journal Taper Per Inch Maximum	Crankshaft Free End Play ^②
5.8L (351 CID) M-V-8 6.6L (400 CID) V-8	2.3103-2.3111	.0006	.004-.008

① Maximum out-of-round — .0006.

② Service limit — .012.

CRANKSHAFT BEARINGS

Engine	Connecting Rod Bearing to Crankshaft Clearance Selective Fit			Main Bearing to Crankshaft Clearance Selective Fit		
	Desired	Allowable	Bearing Wall Thickness Std. ^①	Desired	Allowable	Bearing Wall Thickness Std. ^①
5.8L (351 CID) M-V-8 6.6L (400 CID) V-8	.0008-.0015	.0008-.0025	.0622-.0625	.0008-.0015	.0008-.0026	.0955-.0960

① For .002 undersize add .001 to standard wall thickness.

CONNECTING ROD

Engine	Piston Pin Bore or Bushing I.D.	Rod Bearing Bore I.D. ^①	Rod Length Center to Center	Connecting Rod Alignment Maximum Total Difference		Rod to Crankshaft Assembled Side Clearance ^③
				Twist ^②	Bend ^②	
5.8L (351 CID) M-V-8 6.6L (400 CID) V-8	.9726-.9742	2.4361-2.4369	6.5785-6.5815	.024	.012	.010-.020

① Connecting rod bearing bore maximum out-of-round — .0004.

② Pin bushing and crankshaft bore must be parallel and in same vertical plane within specified total difference when measured at the ends of an 8-inch long bar, 4 inches on each side of rod centerline.

③ Service limit — .023.

PISTON

Engine	Diameter ^①			Piston to Bore Clearance Selective Fit	Piston Pin Bore Diameter	Ring Groove Width Compression		
	Coded Red	Coded Blue	.003 Oversize			Top	Bottom	Oil
5.8L (351 CID) M-V-8 6.6L (400 CID) V-8	3.9982-3.9988	3.9994-4.0000	4.0006-4.0012	.0014-.0022	.9754-.9757	.080-.081	.080-.081	.188-.189

① Measured at the piston pin bore centerline at 90° to the pin.

PISTON PIN

Engine	Length	Standard	Diameter .001 Oversize	.002 Oversize	To Piston Pin Bore Clearance	To Connecting Rod Bushing Clearance
5.8L (351 CID) M-V-8 6.6L (400 CID) V-8	3.150-3.170	.9749-.9754	.9760-.9763	.9770-.9773	.0003-.0005	Interference Fit

① Selective Fit.

PISTON RINGS

Engine	Ring Width Compression		Side Clearance Compression			Ring Gap Compression		
	Top	Bottom	Top	Bottom	Oil	Top	Bottom	Oil ^②
5.8L (351 CID) M-V-8 6.6L (400 CID) V-8	.0770-.0780	.0770-.0780	.0019-.0036	.002-.004	Snug	.010-.020	.010-.020	.010-.035

① Service limit — .002 maximum increase in clearance.

② Steel rail.

OIL PUMP AND OIL CAPACITY

Engine	Relief Valve Spring Pressure (lbs) @ Spec. Length	Driveshaft to Housing Clearance	Relief Valve to Housing Clearance	Rotor Assembly End Clearance	Outer Race to Housing Clearance	Engine Oil Capacity Qts. — U.S. ①
5.8L (351 CID) V-8 6.6L (400 CID) V-8	20.6-22.6 @ 2.49	.0015-.0030	.0015-.0030	.004 Maximum	.001-.003	5

① Add 1 qt. when replacing filter.

FUEL PUMP — MECHANICAL

Engine	Static Pressure (PSI) ①	Volume Flow — Minimum ① ②	Eccentric Total Lift — Inches
5.8L (351 CID) M-V-8 6.6L (400 CID) V-8	6.0-8.0	1 pint in 20 seconds	.602-.622

① On the engine with temperatures normalized and at normal curb idle speed, in neutral.

② The inside diameter of the smallest passage in the test flow circuit must not be less than .220.

TORQUE LIMITS — 5.8L (351 CID) V-8, 6.6L (400 CID) V-8 ENGINE

NOTE: All values are in N•m (ft-lbs), unless otherwise noted. Oil threads with engine oil unless the threads require oil or water-resistant sealer. The standard torque limits listed below are applicable for all functions not listed in the special torque chart.

1/4-20	5/16-18	5/16-24	3/8-16	3/8-24	7/16-14	7/16-20	1/2-13	9/16-18
8-12 (6-9)	17-24 (12-18)	19-27 (14-20)	30-43 (22-32)	37-51 (27-38)	61-77 (45-57)	55-81 (40-60)	75-81 (55-60)	116-162 (85-120)

Pipe Threads

1/8-27	1/4-18	3/8-18	1/2-14
7-11 (5-8)	17-24 (12-18)	30-44 (22-33)	34-47 (25-35)

Item	Torque	
	N•m	(ft-lbs)
Camshaft Sprocket — Gear to Camshaft	55-61	(40-45)
Camshaft Thrust Plate to Cylinder Block	13-16	(9-12)
Connecting Rod Nut	55-61	(40-45)
Cylinder Front Cover	17-24	(12-18)
Cylinder Head Bolts	①	
Damper to Crankshaft	95-122	(70-90)
EGR Valve to Carburetor Spacer or Intake Manifold	17-24	(12-18)
Fuel Pump to Cylinder Block or Front Cover — Nut	19-27	(14-20)
— Bolt	14-20	(10-15)
Flywheel to Crankshaft	102-115	(75-85)
Main Bearing Cap Bolts	129-142	(95-105)
Manifold to Cylinder Head — Intake — 3/8"	30-43	(22-32)
— 5/16"	26-33	(19-25)
Manifold to Cylinder Head — Exhaust	25-32	(18-24)
Oil Filter Insert to Cylinder Block/Adaptor	28-40	(20-30)
Oil Filter to Adaptor or Cylinder Block	1/2 turn after gasket contacts sealing surface — oiled gasket	
Oil Inlet to Main Bearing	30-43	(22-32)
Thermactor Pump Bracket to Cylinder Block	44-68	(30-45)
Carburetor Mounting Stud	7-13	(5-10)
Distributor Clamp Down	25-33	(17-25)
Intake Manifold Vacuum Fittings	8-13	(6-10)
Oil Pan Drain Plug	21-33	(15-25)
Oil Pump to Cylinder Block	30-43	(22-32)
Oil Pan to Cylinder Block — 1/4"	10-12	(7-9)

Item	Torque	
	N•m	(ft-lbs)
Pulley to Damper Bolt	48-67	(35-50)
Rocker Arm Stud/Bolt to Cylinder Head	25-33	(18-25)
Spark Plug to Cylinder Head	14-20	(10-15)
Valve Rocker Arm Cover	4-6	(3-5)
Water Outlet Housing	17-24	(12-18)
Water Pump to Block/Front Cover	17-24	(12-18)
Alternator Bracket to Cylinder Block — Bolt	21-27	(15-20)
Alternator Adjusting Arm to Cylinder Block Bolt	21-27	(15-20)
Alternator Adjusting Arm to Alternator Bolt	33-60	(24-40)
Thermactor Pump Pivot Bolt	48-61	(35-45)
Thermactor Pump Adjusting Arm to Pump	30-43	(22-32)
Thermactor Pump Pulley to Pump Hub	17-24	(150-220 in-lbs)
Fuel Filter to Carburetor	10-11	(80-100 in-lbs)
Carburetor Attaching Nuts	17-20	(12-15)

① Torque in steps: first to 102 (75), then to 129-142 (95-105).

MANUAL TRANSMISSION SHIFT SCHEDULE

ENGINE TIMING SPECIFICATION

TIMING RPM SPECIFICATION

CHOKE SETTING SPECIFICATION

FAST IDLE RPM SPECIFICATION

CURB IDLE RPM SPECIFICATION

SPECIFICATION THROTTLE SOLENOID POSITIONER OFF RPM

ENGINE TYPE

TRANSMISSION GEAR POSITION DURING ADJUSTMENT

TRANSMISSION TYPE

SPARK PLUG TYPE AND GAP SPECIFICATION

CATALYST OR NON-CATALYST

FORD MOTOR COMPANY

VEHICLE EMISSION CONTROL INFORMATION

EVAPORATIVE FAMILY IS

VACUUM HOSE ROUTING

ENGINE FAMILY

ENGINE DISPLACEMENT

TRANS

SPARK PLUG GAP

CATALYST

SHIFT SCHED

		TRANSMISSION GEAR	
		NEUTRAL	DRIVE
IGNITION TIMING			
MAX. TIMING RPM			
CHOKE SETTING			
FAST IDLE RPM	HIGH CAM		
	KICK DOWN		
CURB IDLE RPM	A/C		
	NON A/C		
TSP OFF RPM	A/C		
	NON A/C		

SET PARKING BRAKE AND BLOCK WHEELS. DISCONNECT AUTOMATIC BRAKE RELEASE AND SENSOR CONNECTOR FROM DUAL MODE IGNITION MODULE IF SO EQUIPPED. MAKE ALL ADJUSTMENTS WITH ENGINE AT NORMAL OPERATING TEMPERATURE, A/C AND HEADLIGHTS OFF AND AIR CLEANER IN POSITION WHEN CHECKING ALL ENGINE SPEEDS. DISCONNECT AND PLUG IDP THERMATOR AIR

BY-PASS VALVE VACUUM HOSE AND CONNECT A VACUUM HOSE FROM MANIFOLD VACUUM TO THE BY-PASS VALVE (AIR BPV).

ADJUST IGNITION TIMING AND TIMING RPM TO SPEC. WITH VACUUM HOSE(S) DISCONNECTED AND PLUGGED AT THE DISTRIBUTOR. IF EQUIPPED WITH A THROTTLE SOLENOID POSITIONER DASHPOT DISCONNECT SOLENOID WIRE AND COLLAPSE THE DASHPOT. SET RPM USING CARBURETOR SET SCREW.

FAST IDLE ADJUST RPM TO SPEC. WITH TRANS IN NEUTRAL (M/T) OR PARK (A/T). FAST IDLE CAM IN SPECIFIED POSITION. D/P EGR VALVE VACUUM HOSE AT A. D/P PURGE VALVE VACUUM HOSE AT B.

CURB IDLE ADJUST RPM TO SPEC. WITH TRANS IN SPECIFIED MODE AND ALL VACUUM HOSES CONNECTED EXCEPT BY-PASS VALVE. THROTTLE SOLENOID POSITIONER ENERGIZED AND DASHPOT COLLAPSED IF SO EQUIPPED.

TSP OFF ADJUST RPM TO SPEC. WITH THROTTLE SOLENOID POSITIONER WIRE DISCONNECTED AND THE DASHPOT COLLAPSED IF SO EQUIPPED.

IDLE MIXTURE IS PRESET AT FACTORY. NOT ADJUSTED DURING SCHEDULED MAINTENANCE.

COMPLIANCE DEMONSTRATED BELOW 4000 FT.

ADJUSTMENT PROCEDURE NOTES

THIS VEHICLE CONFORMS TO U.S.E.P.A. REGULATIONS APPLICABLE TO 1980 MODEL YEAR NEW MOTOR VEHICLES

A5090-2A

7.5L (460 CID) V-8 Engines

PART 21-24

APPLIES TO ALL MODELS

SUBJECT	PAGE	SUBJECT	PAGE
ADJUSTMENTS		REMOVAL AND INSTALLATION (Cont'd.)	
Valve Clearance	21-24-6	Cylinder Front Cover and Timing Chain	21-24-16
DESCRIPTION		Cylinder Heads	21-24-14
Cooling System	21-24-6	Engine	21-24-7
Crankcase	21-24-1	Engine Front Supports	21-24-9
Engine	21-24-1	Engine Rear Supports	21-24-10
Exhaust	21-24-1	Exhaust Manifolds	21-24-15
Lubrication System	21-24-1	Flywheel	21-24-20
DISASSEMBLY AND ASSEMBLY		Front Oil Seal	21-24-18
Cylinder Assembly — 6009	21-24-28	Intake Manifold	21-24-12
Cylinder Block — 6010	21-24-29	Main Bearing	21-24-21
Cylinder Head	21-24-27	Oil Filter	21-24-26
Pistons and Connecting Rod	21-24-28	Oil Pan	21-24-20
Valve Tappet	21-24-27	Oil Pump	21-24-21
REMOVAL AND INSTALLATION		Pistons and Connecting Rods	21-24-22
Camshaft	21-24-19	Valve Tappet	21-24-14
Camshaft Bearings	21-24-25	Valve Rocker Arm Cover and Rocker Arm	21-24-10
Camshaft Rear Bearing Bore Plug	21-24-20	Valve Spring, Retainer and Stem Seal	21-24-11
Connecting Rod Bearing	21-24-22	Water Pump	21-24-16
Crankcase Ventilation System	21-24-10	SPECIFICATIONS	21-24-30
Crankshaft	21-24-24		
Crankshaft Rear Oil Seal	21-24-21		

DESCRIPTION

ENGINE

The 7.5L (460 CID), 4 venturi V-8 engine has a low weight cast iron cylinder block. The crankshaft is precision cast, nodular iron alloy and has five main bearings. The pistons are autothermic cast aluminum alloy, tin plated. Valve rocker arms are pedestal mounted and the tappets are hydraulic. Large chrome plated intake and exhaust valves provide optimum breathing. A low restriction air cleaner is utilized for maximum clean air intake. Refer to the chart at the end of this part for complete specifications.

The 7.5L (460 CID) engine is optional for E-250 and E-350 models.

The illustrations shown in Figs. 1 and 2 are typical and will serve as a reference to the procedures outlined. The part descriptions and basic numbers in the illustration keys correspond with the Ford Master Parts Catalog.

EXHAUST EMISSION CONTROL SYSTEM

Operation, removal, installation and required maintenance of the exhaust emission control devices used on this engine are covered in Group 29 of this Manual.

CRANKCASE VENTILATION SYSTEM

The 7.5L (460 CID) V-8 engines have a positive closed-type crankcase ventilation system recycling the crankcase vapors to the intake manifold.

LUBRICATION SYSTEM

The heart of the lubrication system is a full pressure cast iron pump. The high capacity "G" rotor design pump is driven by a hex shaft from the distributor. The pressure is relief-valve controlled.

Oil is directed through drilled oil passages to the full flow oil filter, from the filter to the main oil galleries,

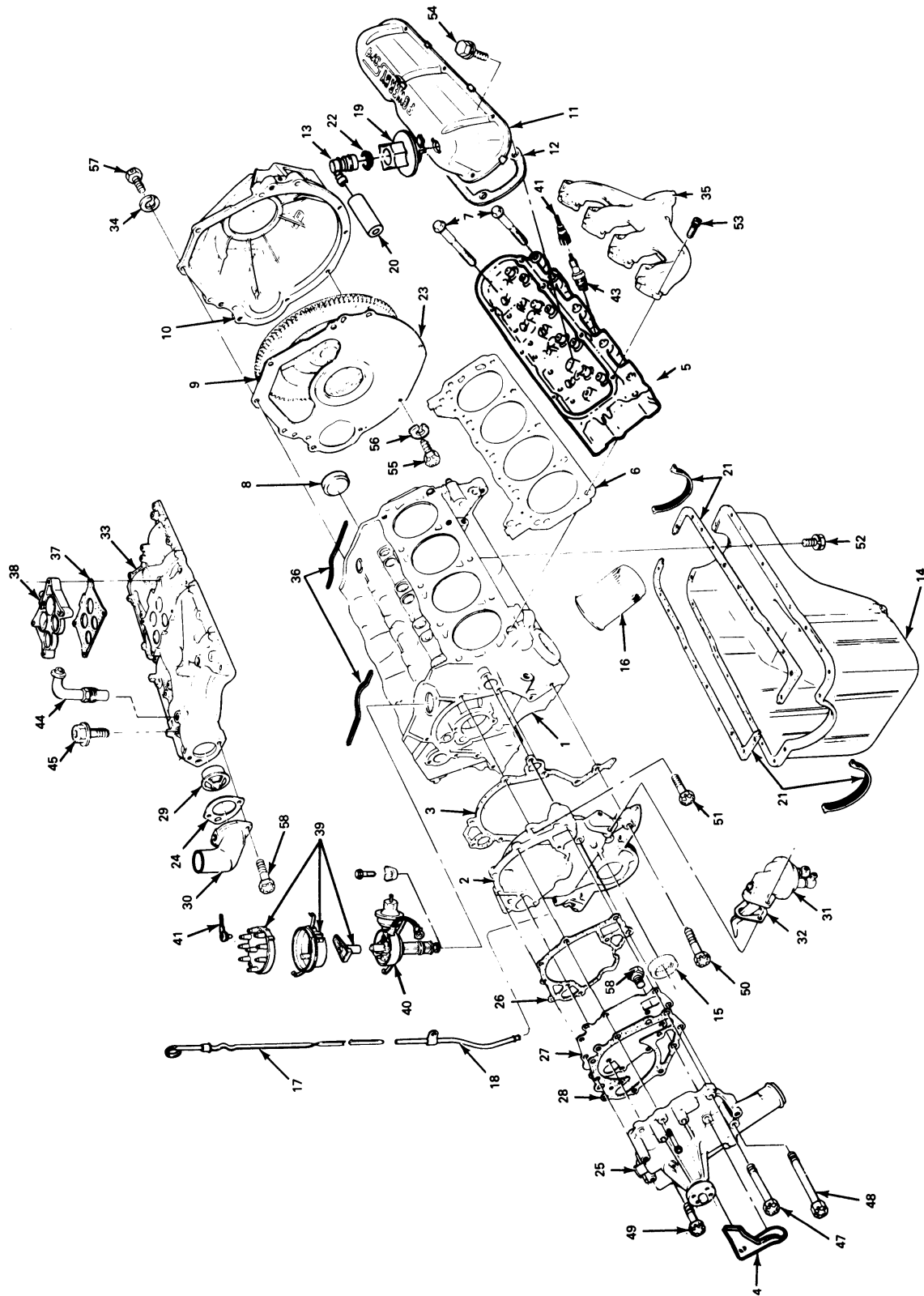


FIG. 1 External Exploded View—7.5L (460 CID) V-8 Engine

REF. NO.	BASIC PART NO.	DESCRIPTION	REF. NO.	BASIC PART NO.	DESCRIPTION	REF. NO.	BASIC PART NO.	DESCRIPTION
1	6009	Cylinder Assy. — (Includes internal parts)	38	9A589	Spacer — Carburetor to Intake Manifold			
2	6019	Cover Assy. — Cylinder Front	39	12106	Distributor — Parts			
3	6020	Gasket — Cylinder Front Cover	40	12127	Distributor Assy.			
4	6023	Pointer — Timing	41	12259	Wire Set — Spark Plug			
5	6049	Head — Cylinder	42	12270	Clamp — Distributor			
6	6051	Gasket — Cylinder Head	43	12405	Spark Plug Assy.			
7	6065	Bolt — Cylinder Head	44	18599	Elbow — Hot Water Connection			
8	6266	Plug — Camshaft Rear Bearing	45	56126-S	Bolt — Washer Head — 5/16-18 x 7/8"			
9	6375	Flywheel Assy.						
10	6392	Housing Assy. — Flywheel	46	20386-S	Bolt — 5/16-18 x 1"			
11	6582	Cover Assy. — Valve Rocker Arm	47	383765-S	Bolt — 5/16-18 x 3-5/8"			
12	6584	Gasket — Valve Rocker Arm Cover	48	300958-S	Bolt — 5/16-18 x 5"			
13	6B890	Elbow & Valve Assy. — Positive Crankcase Ventilation (P.C.V.)	49	56128-S	Bolt — 5/16-18 x 2-1/2"			
			50	56126-S	Bolt — 5/16-18 x 2"			
14	6675	Pan Assy. — Oil	51	376256-S	Bolt or Screw — 5/16-18 x 1"			
15	6700	Seal — Cylinder Front Cover	52	373564-S	Bolt — 5/16-18 x 1-7/8"			
16	6731	Element Assy. — Oil Filter	53	381731-S	Bolt — 3/8-16 x 1-7/8"			
17	6750	Indicator — Oil Level	54	356748-S	Bolt — 1/4-20 x 5/8"			
18	6754	Tube Assy. — Oil Level Indicator	55	20346-S	Bolt — 5/16-18 x 3/4"			
19	6766	Cap Assy. — Oil Filler	56	34806-S	Washer — Lock — 5/16 x 19/32 x 5/64"			
20	381187	Hose — Positive Crankcase Ventilation	57	20508-S	Bolt — 7/16-14 x 1-3/4"			
21	6781	Gasket Set — Oil Pan	58		Bolt — 5/16 — 18			
22	6A892	Retainer — Crankcase Ventilation — Grommet						
23	7007	Plate Assy. — Engine Rear						
24	8255	Gasket — Water Outlet Connection						
25	8501	Pump Assy. — Water						
26	8507	Gasket — Water Pump Housing						
27	8508	Cover — Water Pump						
28	8513	Gasket — Water Pump Cover						
29	8575	Thermostat — Water						
30	8592	Connection — Water Outlet						
31	9350	Pump Assy. — Fuel						
32	9417	Gasket — Fuel Pump Mounting						
33	9424	Manifold — Intake						
34	34808-S	Washer — Lock — 7/16"						
35	9430	Manifold — Exhaust						
36	9433	Gasket Set — Manifold						
37	9447	Gasket — Carburetor						

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FIG. 1 External Exploded View—Key

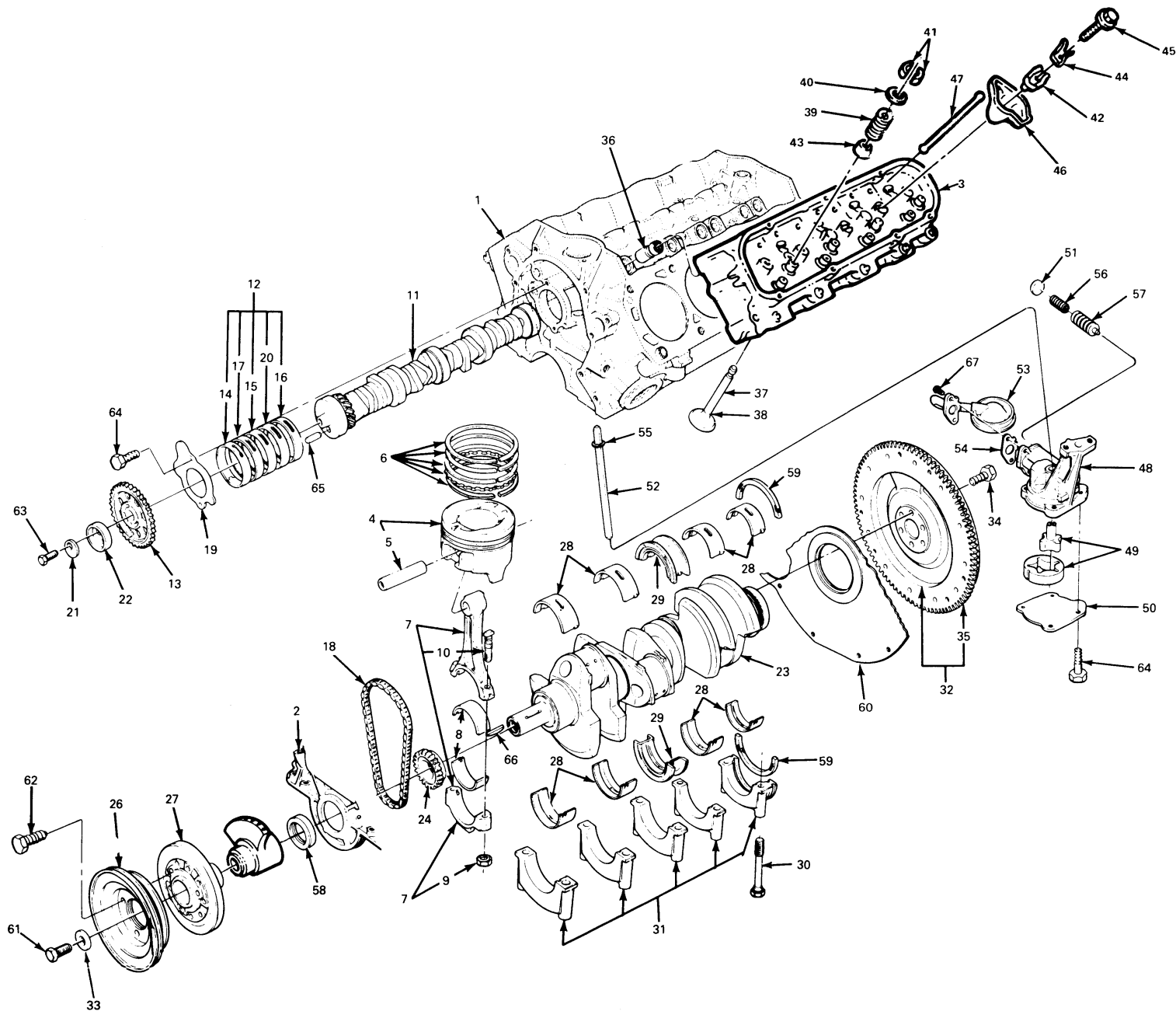


FIG. 2 Internal Exploded View—7.5L (460 CID) V-8 Engine

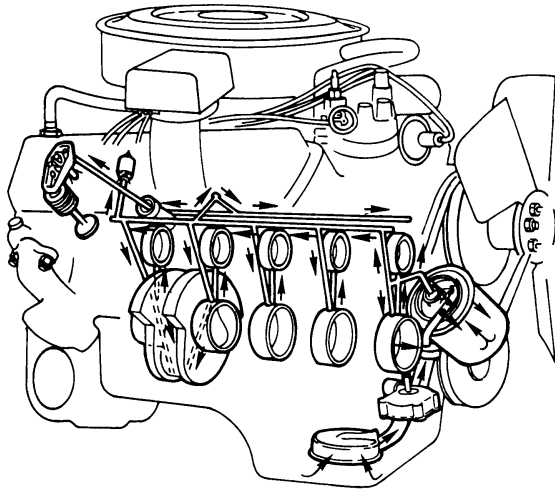
Ref. No.	Basic Part No.	Description	Ref. No.	Basic Part No.	Description
1	6010	Block Assy. (Internal parts not included)	34	6379	Bolt — Flywheel to Crankshaft
2	6019	Cover Assy. — Cylinder Front	35	6384	Gear — Flywheel Ring
3	6049	Head — Cylinder	36	6500	Tappet Assy. — Hydraulic
4	6108	Piston Assy.	37	6505	Valve — Exhaust
5	6135	Pin — Piston	38	6507	Valve — Intake
6	6148	Ring Set — Piston	39	6513	Spring — Valve
7	6200	Rod Assy. — Connecting	40	6514	Retainer — Valve Spring
8	6211	Bearing — Connecting Rod	41	6518	Key — Valve Spring Retainer
9	6212	Nut — Connecting Rod	42	6A528-A	Fulcrum
10	6214	Bolt — Connecting Rod	43		Valve Stem Seal
11	6250	Camshaft	44	6A53-1	Oil Deflector
12	6251	Bearing Kit — Camshaft — Standard	45	6A527-A	Bolt — Rocker Arm Attach
13	6256	Sprocket — Camshaft (Nylon)	46	6564	Arm — Valve Rocker
14	6261	Bearing — Camshaft Front	47	6565	Rod — Valve Push
15	6262	Bearing — Camshaft Center	48	6600	Pump Assy. — Oil
16	6263	Bearing — Camshaft Rear	49	6608	Rotor and Shaft Assy. — Oil
17	6267	Bearing — Camshaft Front Intermediate	50	6616	Pump Drive
18	6268	Chain — Timing	51	6A616	Plate — Oil Pump Body
19	6269	Plate — Camshaft Thrust	52	6A618	Plug — Oil Pump Relief Valve
20	6270	Bearing — Camshaft Rear Intermediate	53	6622	Shaft Assy. — Oil Pump Intermediate
21	6278	Washer — Camshaft Sprocket	54	6626	Screen, Tube and Cover Assy. — Oil Pump
22	6287	Eccentric — Camshaft Fuel Pump	55	6629	Gasket — Oil Pump Inlet Tube
23	6303	Crankshaft Assy.	56	6670	Ring — Oil Pump Intermediate Shaft
24	6306	Sprocket — Crankshaft	57	6674	Spring — Oil Pump Relief Valve
25	6359	Spacer — Damper	58	6700	Plunger — Oil Pump Relief Valve
26	6A312	Pulley Assy. — Crankshaft Outer	59	6701	Seal — Cylinder Front Cover Oil
27	6316	Damper Assy. — Crankshaft	60	7007	Packing — Crankshaft Rear
28	6333	Bearing — Crankshaft Main (except center)	61	377850-S	Plate — Engine Rear
29	6337	Bearing — Crankshaft Main (center)	62	42998-S	Bolt — 5/8-18 x 2"
30	6345	Bolt — Crankshaft Main Bearing Cap	63	43002-S	Bolt — 3/8-16 x 1"
31	*	Main Bearing Cap — Supplied in 6010 Block Assy.	64	42911-S	Bolt — 3/8-16 x 1-1/2"
32	6375	Flywheel Assy.	65	378189-S	Bolt — 1/4-20 x 5/8"
33	6378	Washer — Crankshaft Pulley Retaining	66	372854-S	Pin — Dowel — 5/16 x 1-3/8"
			67	357235-S	Key — Woodruff — 1-3/4 x 7/32 x 3/16"
					Bolt — 5/16-18 x 7/8"

A4942-2A

FIG. 2 Internal Exploded View—Key

which intersect the valve guide bores. A drilled gallery (crossover) at the rear of the tappet chamber routes oil to the left bank. The main, connecting rod, and camshaft bearings are supplied oil from the right hand oil gallery.

Oil flow to the camshaft sprocket, fuel pump eccentric, and timing chain is through an annulus and drilled passage at the front of the No. 1 camshaft bearing. Oil flow to the rocker arms is through the valve lifters and up the push rods to the arms.

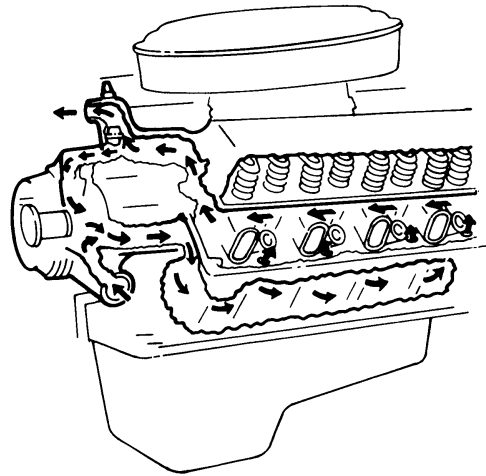


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FIG. 3 Lubrication System Schematic

COOLING SYSTEM

The cooling system is a series-parallel flow. Coolant flow is from the water pump through passages in the front cover (both sides) to the cylinder block. Flow continues through the block to the rear and up through the deck or head faces, then forward through the cylinder heads to the water crossover at the front of the intake manifold, through the water outlet (thermostat housing) and to the top of the radiator.



A5505-1A

FIG. 4 Cooling System Schematic

ADJUSTMENTS

VALVE CLEARANCE

The valve arrangement on the left bank is E-I-E-I-E-I-E-I and on the right bank is I-E-I-E-I-E-I-E.

A 0.060 inch shorter push rod or a 0.060 inch longer push rod are available for service to provide a means of compensating for dimensional changes in the valve mechanism. Refer to the Master Parts List or the specifications for the pertinent color code.

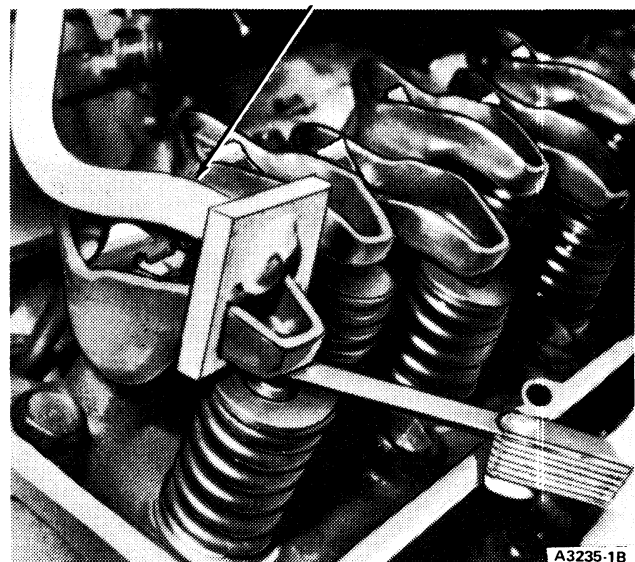
Valve stem to valve rocker arm clearance should be within specifications listed at the end of this Part. with the hydraulic tappet completely collapsed. Repeated valve reconditioning operations (valve and/or valve seat refacing) will decrease the clearance to the point that if not compensated for, the hydraulic valve tappet will cease to function and the valve will be held open.

To determine whether a shorter or a longer push rod is necessary, make the following check:

1. Install an auxiliary starter switch. **Crank the engine with the ignition switch OFF until the No. 1 piston is on TDC after the compression stroke.**
2. With the crankshaft in the positions designated in Steps 3, 4 and 5, position the hydraulic tappet compressor tool on the rocker arm. Slowly apply pressure to bleed down the hydraulic tappet until the plunger is completely bottomed (Fig. 5). Hold

the tappet in this position and check the available clearance between the rocker arm and the valve stem tip with a feeler gauge. If the clearance is less than specifications, install a shorter push rod. If the clearance is greater than specifications, install a longer push rod.

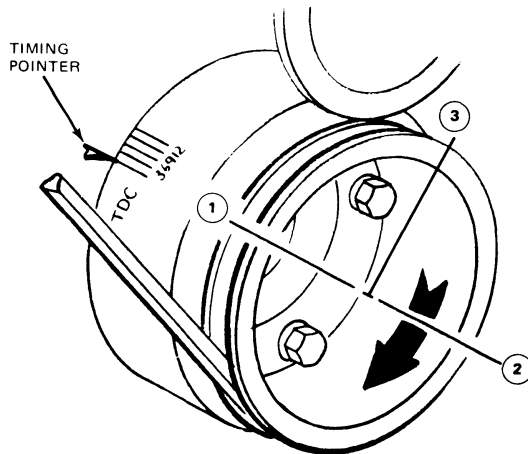
TOOL-T71P-6513-A



A3235-1B

FIG. 5 Checking Valve Clearance

With No. 1 at TDC at end of compression stroke make a chalk mark at points 2 and 3 approximately 90 degrees apart.



POSITION 1 — No. 1 at TDC at end of compression stroke.

POSITION 2 — Rotate the crankshaft 180 degrees (one half revolution) clockwise from POSITION 1.

POSITION 3 — Rotate the crankshaft 270 degrees (three quarter revolution clockwise from POSITION 2.

A3234-1D

FIG. 6 Positioning Crankshaft for Checking Valve Clearance and Installing Rocker Arms

3. With the No. 1 piston on TDC at the end of the compression stroke as shown in POSITION NO. 1, Fig. 6, check the following valves:
 - No. 1 Intake No. 1 Exhaust
 - No. 7 Intake No. 5 Exhaust
 - No. 8 Intake No. 4 Exhaust
4. After checking the spacing on these valves, rotate the crankshaft to POSITION NO. 2 as shown in Fig. 4 then check the following valves:
 - No. 4 Intake No. 2 Exhaust
 - No. 5 Intake No. 6 Exhaust
5. After checking the spacing on these valves, rotate the crankshaft to POSITION NO. 3 as shown in Fig. 4 and check the following valves:
 - No. 2 Intake No. 3 Exhaust
 - No. 3 Intake No. 7 Exhaust
 - No. 6 Intake No. 8 Exhaust

REMOVAL AND INSTALLATION

When installing nuts or bolts that must be tightened (refer to torque Specifications listed at the end of this Part), oil the threads with light-weight engine oil. **Do not oil threads that require oil-resistant or water-resistant sealer.**

Refer to Part 21-01 for Cleaning, Inspection and Test procedures.

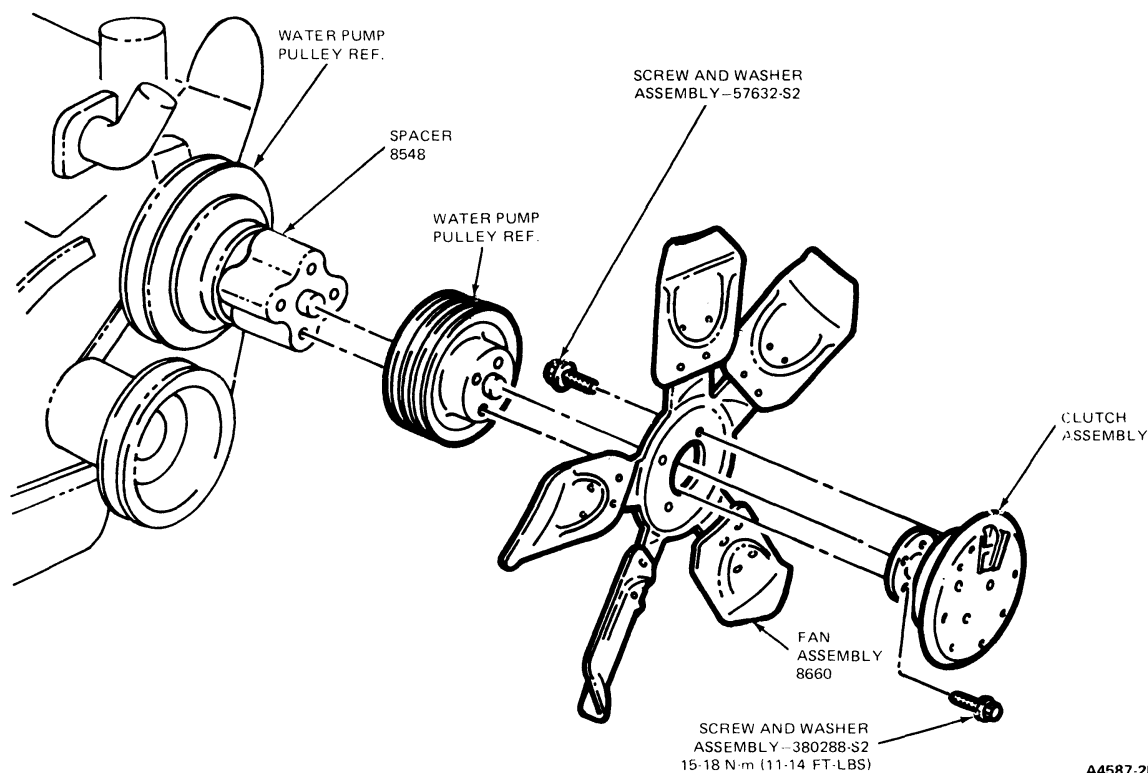
ENGINE

The engine removal and installation procedures are for the engine only without the transmission attached.

E-250—E-350

Removal

1. Remove engine cover, open the hood, disconnect battery, drain cooling system (refer to Part 27-02, General Cooling System Service) and remove the grill assembly including gravel deflector.
2. Remove the upper grille support bracket, hood lock support and condenser upper mounting brackets.
3. If so equipped, discharge the A/C system, and remove the A/C condenser (refer to Group 36). Disconnect the A/C lines at the compressor, and remove the accelerator cable bracket. Disconnect the two heater hoses from the engine.
4. Disconnect the upper radiator hose.
5. Disconnect radiator lower hose at the radiator. If so equipped, disconnect the oil cooler lines at the radiator.
6. Remove the fan shroud and fan assembly (Fig. 7). Remove the radiator from the vehicle (refer to Part 27-04, Radiators). Pivot the alternator inward. Disconnect the alternator lead wires at the alternator.
7. Remove the air cleaner assembly, also remove the duct and valve assembly and exhaust manifold shroud. Remove the flex tube from the exhaust manifold stove. Disconnect the throttle and transmission linkage at the carburetor and remove the accelerator cable bracket from the engine.
8. Disconnect the fuel line, choke lines, and then remove the carburetor and carburetor spacer (Includes disconnecting vacuum lines). Raise the vehicle on hoist, drain the crankcase, and remove the oil filter.
9. Disconnect the muffler inlet pipe at the exhaust manifolds. Remove two bolts retaining the transmission filler tube bracket to the right cylinder head.
10. Remove the engine mount attaching bolts and nuts (Fig. 8). Remove the starter motor and disconnect the cable (refer to Group 28). Remove the converter inspection cover bolts.



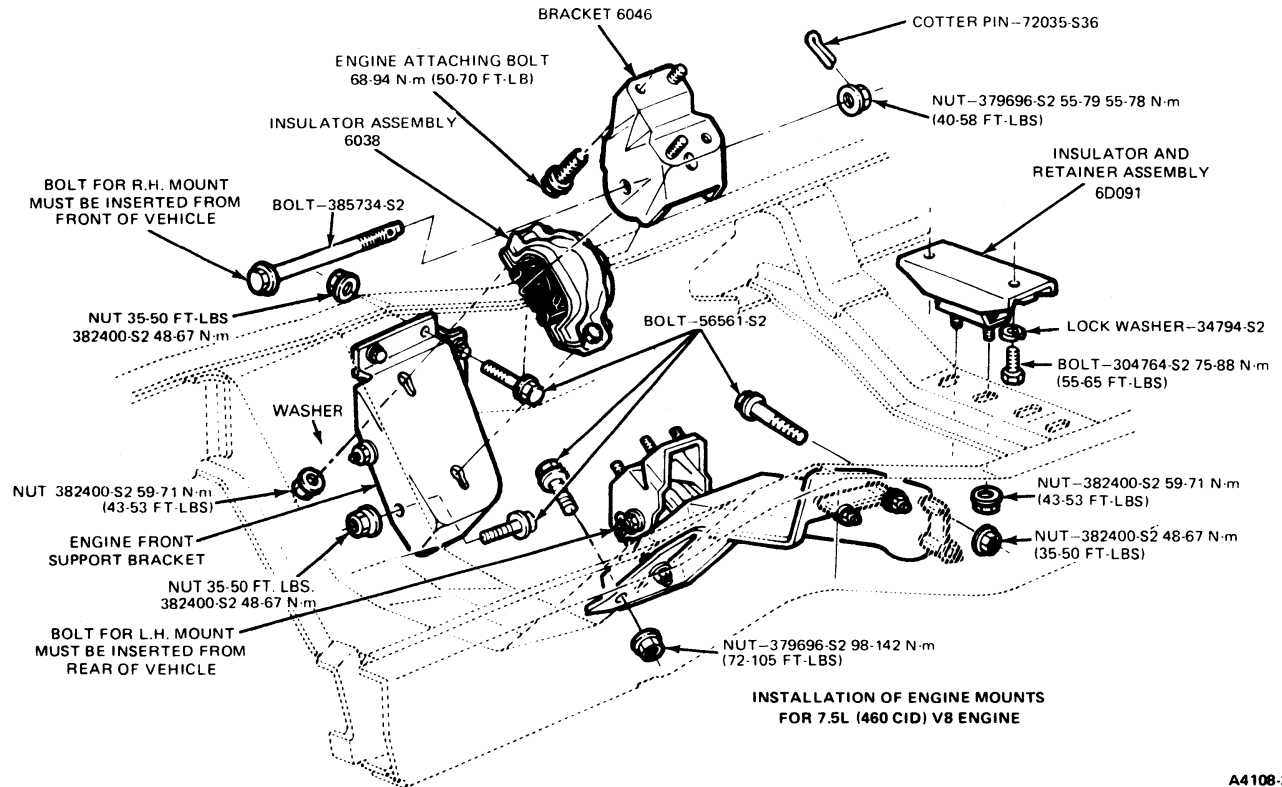
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FIG. 7 Fan Blade Assembly E-250—E-350

11. Remove four nuts attaching the converter to the flex plate.
12. Remove three bolts retaining the adapter plate to the converter housing.
13. Remove four converter housing-to-cylinder block lower bolts. Remove the bolt attaching the ground (—) cable to the cylinder block. Lower the vehicle on hoist.
14. If so equipped, loosen the power steering pump bracket and remove the drive belt. Remove the power steering front face bracket bolts.
15. Disconnect only one vacuum line at the rear of the intake manifold. Disconnect the engine wire loom and position it out of the way.
16. Remove the speed control servo and the accelerator cable bracket from the intake manifold, and position them out of the way (three retaining bolts).
17. If so equipped, disconnect the A/C compressor magnetic clutch load wire. Install the lifting sling (Tool No. 75T-6000-A) or equivalent to the intake manifold (attaching bolts). Remove two converter housing-to-cylinder block upper bolts.
18. Position a floor jack under the transmission for support. Position a floor crane to the vehicle and connect it to the lifting sling which is attached to the intake manifold.
19. Remove the engine from the vehicle.

Installation

1. Connect the floor crane to the engine, raise the engine and position it into the vehicle aligning the transmission converter to the flywheel (or flex plate) and the engine dowels to the transmission. Lower the engine to the chassis brackets, and align the through-bolt holes (Fig. 8). Disconnect the floor crane and position it out of the way.
2. Remove floor jack from under the transmission, and position it out of the way.
3. Install two converter housing-to-cylinder block lower bolts. Remove the lifting bracket from the intake manifold (bolts).
4. If so equipped, connect the A/C compressor magnetic clutch lead (refer to Group 36).
5. Connect the flex tube to the exhaust manifold stove. Position the accelerator cable mounting bracket and the speed control servo to the intake manifold, and install three attaching bolts.
6. Position the engine wire harness in retainers and connect at respective locations. Connect three vacuum lines at the rear of the intake manifold.
7. Connect two heater hoses, one at the heater core and one at the water valve. If so equipped position the power steering front face bracket and the power steering pump to the water pump and the left cylinder head. Install the six attaching bolts.
8. Position the power steering pump drive belt to its respective pulleys, adjust belt tension to Specification listed at the end of this Part and tighten the attaching bolts. If so equipped, connect two A/C lines at the A/C compressor, and install the accelerator cable bracket to the dash (refer to Group 36).
9. Raise the vehicle on a hoist. Install one bolt attaching ground cable to cylinder block. Install four lower converter housing-to-cylinder block



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FIG. 8 Engine Supports—E-250—E-350

lower bolts. Install the three adapter plate-to-converter housing bolts. Install four nuts attaching the converter to the flex plate. Install the converter inspection cover (bolts).

10. Install the starter motor and connect the cable (refer to Group 28). Install the engine mount attaching bolts and nuts. Tighten to specifications (Fig. 8).
11. Install the two bolts that attach the transmission filler tube bracket to the right cylinder head.
12. Connect the muffler inlet pipe at the exhaust manifolds. Install the oil filter.
13. Lower the vehicle on hoist. Position the carburetor with gasket to the intake manifold, install four nuts, connect the fuel line, choke line, vacuum lines and the choke lead wires.
14. Connect the throttle and transmission linkage at the carburetor. Connect the alternator lead wires to the alternator.
15. Install the fan assembly to the water pump shaft (Fig. 7) and position the shroud over the fan assembly.
16. Position the radiator to the radiator support and secure with four attaching bolts (refer to Part 27-04, Radiators). Install the shroud and secure with four attaching bolts.
17. Connect two oil cooler lines at the radiator, if so equipped.
18. Connect the radiator lower hose at the radiator. Connect the radiator upper hose at the radiator.
19. Install the A/C condenser to radiator support, if so equipped (refer to Group 36). Install the grille upper

support bracket, hood lock support and condenser upper mounting brackets.

20. Install the grille assembly. Fill the crankcase. Fill the cooling system and adjust the tension of drive belt to Specifications (refer to Part 27-02, General Cooling System Service).
21. Connect battery, start engine and check for leaks. Adjust idle speed to specifications on engine decal.
22. Evacuate and charge the A/C system, if so equipped (refer to Part 36-30, Air Conditioning System General Service). Install the air cleaner assembly.
23. Install the engine cover.

ENGINE FRONT SUPPORTS

Front supports (Fig. 8) are located on each side of the cylinder block. Following procedures apply to either support.

Removal

1. Support the engine with a jack and a wood block placed under the oil pan.
2. Remove the four locknuts from the bolts attaching the support bracket (Fig. 8) to the frame crossmember and frame side rail.
3. Remove the through-bolt attaching the engine support bracket to the insulator.
4. Raise the engine with the jack, until the insulator is clear of the cup-shaped engine bracket.
5. Remove the insulator and frame bracket (Fig. 8) as an assembly.

6. Remove the through-bolt attaching the insulator to the frame bracket.

Installation

1. Pre-assemble the insulator to the frame bracket and install the attaching through-bolt. **The insulator should be installed so that the word TOP is visible on either side of the engine (Fig. 8).** As a bench operation, tighten the through-bolt nut to specifications.
2. Position the insulator and frame bracket assembly to the engine insulator bracket and the frame crossmember. Install the through-bolt attaching the insulator to the engine bracket. Lower the engine.
3. Install the locknuts on the bolts attaching the frame bracket to the crossmember. Tighten the through-bolt locknut and the frame bracket attaching bolt locknuts to specifications. Remove the jack and wood block.

ENGINE REAR SUPPORT

Removal

1. Remove the attaching bolts, nut and washer (Fig. 8).
2. Raise the transmission slightly to provide clearance; then, remove the insulator and insulator retainer.

Installation

1. Position the insulator and retainer (Fig. 8), and install the insulator-to-extension housing bolts and lockwashers.
2. Lower the transmission and install the insulator-to-frame crossmember bolt. Tighten the nut and bolts to specifications (Fig. 8).

CRANKCASE VENTILATION SYSTEM

Removal

1. Remove ventilation intake hose from the air cleaner and the elbow at the oil filler cap on left rocker cover.
2. Remove the oil filler cap and separate the elbow and grommet from the cap.

3. Remove the air cleaner and duct assembly.
4. Remove the crankcase ventilation tube (metal) from the carburetor spacer and the PCV valve by disconnecting the rubber connecting hoses at both ends.
5. Remove the PCV valve from the grommet and the grommet from the right rocker cover.

Installation

1. Install the grommet and PCV valve in the right rocker cover.
2. Install the ventilation tube to the PCV valve and the carburetor spacer with the connecting hoses.
3. Install the air cleaner assembly.
4. Install the grommet and elbow to the oil filler cap and install the cap to the left rocker cover.
5. Install the ventilation intake hose to the filler cap elbow and the air cleaner.
6. Start the engine and check for leaks.

VALVE ROCKER ARM COVER AND ROCKER ARM

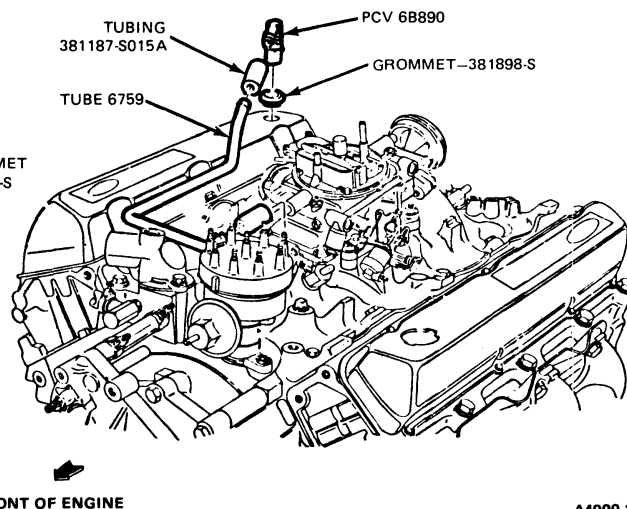
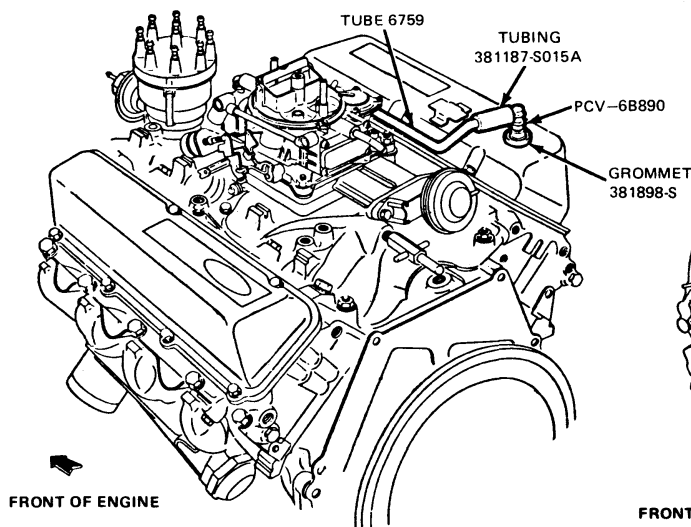
The valve rocker arm is shown in Fig. 10.

Removal

1. Remove the air cleaner and intake duct assembly.
If a right cylinder head rocker arm is to be removed, remove the crankcase ventilation PCV valve from the valve rocker arm cover.
2. Disconnect the spark plug wires from the spark plugs using Tool T68P-6666-A or equivalent. Remove the wires from the bracket on the valve rocker arm cover(s) and position the wires out of the way.
3. Remove the valve rocker arm cover(s).
4. Remove the valve rocker arm bolt, oil deflector, fulcrum seat and rocker arm.

Installation

1. Apply Lubriplate or equivalent to the top of the valve stems, the rocker arm and fulcrum seats.



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FIG. 9 Crankcase Emission Tubing

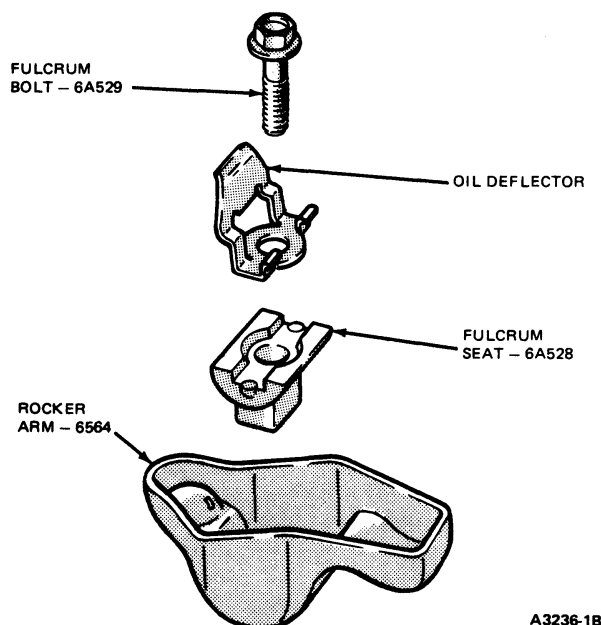


FIG. 10 Rocker Arm and Related Parts

2. Position the No. 1 piston on TDC at the end of the compression stroke, POSITION 1 in Fig. 6, and install the rocker arm, fulcrum seat, oil deflector and bolt on the following valves:

No. 1 Intake No. 1 Exhaust

No. 7 Intake No. 5 Exhaust

No. 8 Intake No. 4 Exhaust

Position the crankshaft in POSITION 2 in Fig. 6 and install the rocker arm, fulcrum seat, oil deflector and bolt on the following valves:

No. 4 Intake No. 2 Exhaust

No. 5 Intake No. 6 Exhaust

Position the crankshaft in POSITION 3 in Fig. 6 and install the rocker arm, fulcrum seat, oil deflector and bolt on the following valves:

No. 2 Intake No. 3 Exhaust

No. 3 Intake No. 7 Exhaust

No. 6 Intake No. 8 Exhaust

Be sure that the fulcrum seat base is inserted in its slot on the cylinder head before tightening the fulcrum bolts. Tighten the fulcrum bolt to specification listed at the end of this Part. Adjust the valve clearance following the procedures under adjustments in this Part.

3. Clean the valve rocker arm cover(s) and the cylinder head gasket surface(s). Position the gasket in the cover, making sure that the gasket tangs are secured in the notches in the cover.
4. Position the cover(s) on the cylinder head(s). Make sure the gasket seats evenly all around the head. Install the bolts. The cover is tightened in two steps. Tighten the bolts to specifications listed at the end of this Part. Two minutes later, tighten the bolts to the same specifications.

If the right cover was removed, install PCV valve. Install the air cleaner and intake duct assembly.

5. Install the spark plug wires in the bracket on the valve rocker arm cover(s). Connect the spark plug wires.
6. Start the engine and check for leaks.

VALVE SPRING, RETAINER AND STEM SEAL

Broken valve springs or defective valve stem seals or retainers may be replaced without removing the cylinder head if valve or valve seat is not damaged.

Removal

1. If a worn or damaged spring, retainer, or seal is on right side of engine, remove air cleaner and intake duct assembly. Remove PCV valve and hose from right valve rocker arm cover.

If worn or damaged spring, retainer, or seal is on left side of engine, remove oil filler cap and ventilation hose from left valve rocker arm cover and position out of way.

2. Remove valve rocker arm cover(s) and applicable spark plug(s).
3. Crank engine until the piston is at TDC at the end of the compression stroke.
4. Remove valve rocker arm bolts, oil deflectors, fulcrum seats, rocker arms, and push rods from affected cylinder(s).
5. Install air line with adapter in spark plug hole. Turn on air supply to hold valves closed.
6. Install Tool T70P-6049-A or equivalent (Fig. 11) and compress valve spring. Remove retainer locks, spring retainer, and spring. Remove and discard valve stem seal (Fig. 12). **If air pressure fails to hold valve in closed position, valve damage affecting sealing is indicated. Remove and inspect cylinder head assembly.**

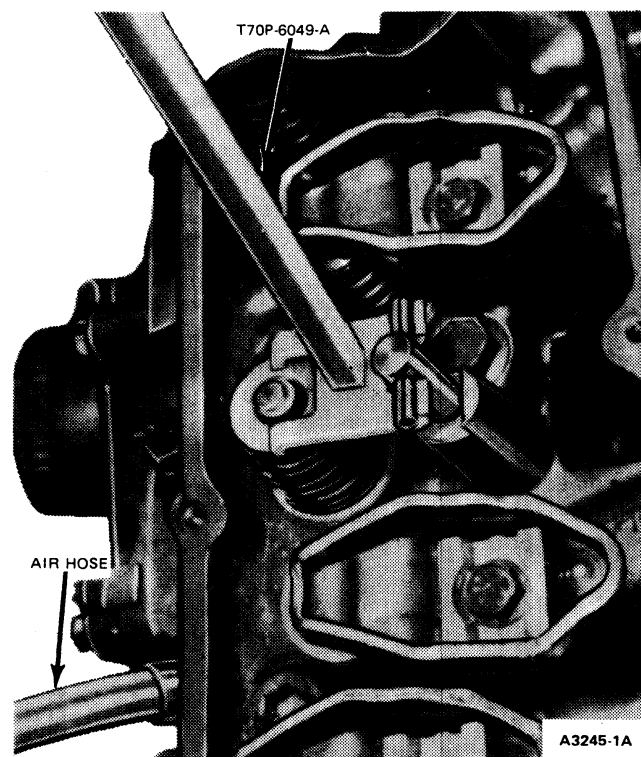


FIG. 11 Compressing Valve Spring—On Bench

sealing is indicated. Remove and inspect cylinder head assembly.

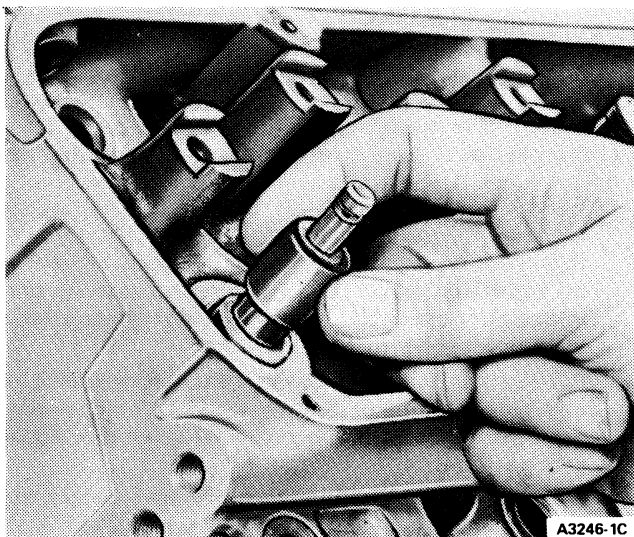


FIG. 12 Removing or Installing Valve Stem Seal

7. Wrap rubber band, tape or string around end of valve stem to prevent valve from dropping into cylinder when air pressure in cylinder is shut off or if piston is at bottom of cylinder. Shut off air pressure.
8. Inspect valve stem for damage. Rotate valve, checking tip for eccentric movement. Move valve up and down through normal travel in valve guide and check for binding. **If valve is damaged, cylinder head must be removed for repairs.**

Installation

1. If valve proves satisfactory, hold valve closed and turn on air pressure in cylinder.
2. Lubricate the valve stems with heavy engine oil SE. Install new valve stem seal on both intake and exhaust valve stem using a 5/8 inch deep wall socket and a light hammer or mallet to seat the seal on the valve stem (Fig. 12). Set spring and retainer over valve stem. Compress valve spring (Fig. 11) and install retainer locks. Release spring and remove tool.
3. Shut off air pressure and remove air line and adapter. Install spark plug.
4. Apply Lubriplate, or equivalent, to tip of valve stem and each end of push rod. Install push rod. **Be sure lower end of push rod is seated in valve lifter.**
5. Lubricate fulcrum seats and sockets with Lubriplate or equivalent.
6. Lubricate the push rod socket, fulcrum seat and the valve pad of the rocker arm with heavy engine oil SE.
7. Install the rocker arms and rocker arm covers using the procedure and sequence given under Rocker Arm Installation in this Part.
If the right cover was removed, install PCV valve.
8. Install the spark plug and connect the spark plug wires.
9. Install the air cleaner and intake duct assembly.

10. Connect the automatic choke heat chamber air inlet hose.

INTAKE MANIFOLD

Removal

1. Drain cooling system. Remove air cleaner and intake duct assembly.
2. Disconnect radiator upper hose at engine.
3. Disconnect heater hoses at intake manifold and water pump, and position out of way. Loosen water pump by-pass hose clamp at intake manifold.
4. Disconnect PCV valve and hose at right valve rocker arm cover. Disconnect all vacuum lines at rear of intake manifold and tag for proper installation.
5. Disconnect wires at spark plugs using Tool T74P-6666-A or equivalent. Remove wires from brackets on valve rocker arm covers. Disconnect coil high tension lead at coil and remove distributor cap and wires as an assembly.
6. Disconnect all distributor vacuum lines at carburetor and vacuum control valve and tag for proper installation. Remove distributor and vacuum lines as an assembly, following the procedure in Part 23-01 for breakerless ignition systems.
7. Disconnect accelerator linkage at carburetor. Remove speed control linkage bracket, if so equipped, from intake manifold and disconnect it from the carburetor. Remove bolts holding accelerator linkage bell crank, remove linkage springs, and position linkage out of way.
8. Disconnect fuel line at carburetor.
9. Disconnect wiring harness at coil battery terminal, engine temperature sending unit, oil pressure sending unit, and other connections as necessary. Disengage wiring harness from three clips at left valve rocker arm cover bolts, and position wiring harness out of way.
10. Remove coil and bracket assembly.
11. Remove attaching bolts and nuts and remove intake manifold and carburetor as an assembly (Fig. 13). **If necessary to pry manifold away from cylinder heads, do not damage gasket sealing surfaces.**

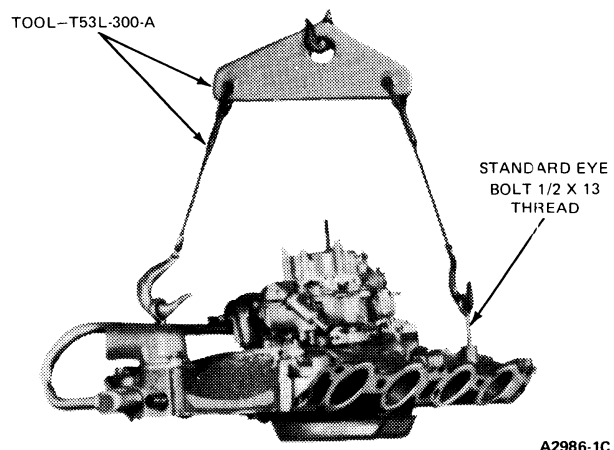


FIG. 13 Removing or Installing Intake Manifold

12. Remove and discard intake manifold gaskets and seals.
13. If manifold is to be further disassembled (Fig. 14), remove coolant outlet housing, gasket, and thermostat. Remove automatic choke heat tubes, carburetor, spacer, and gaskets. Remove the thermostatic choke heater tube. Remove engine temperature sending unit. Remove the EGR valve and gasket. Discard all gaskets.

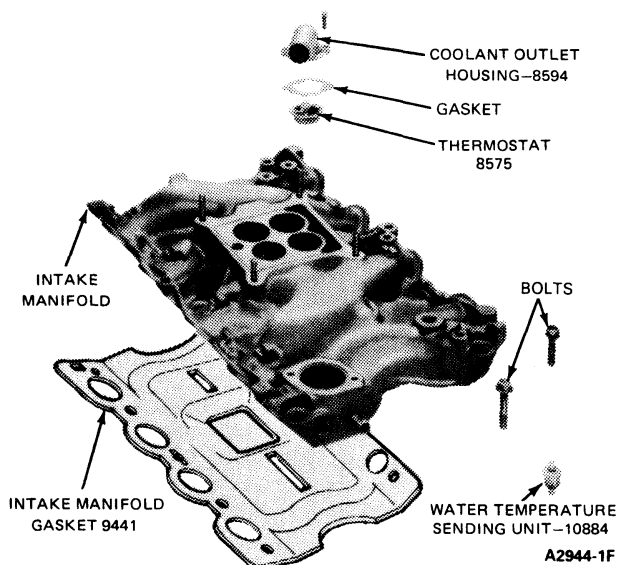


FIG. 14 Intake Manifold Disassembled

14. Remove all gasket material from the machined surfaces of the manifold. Clean the manifold in a suitable solvent and dry it with compressed air.
15. Inspect the manifold for cracks, damaged gasket surfaces, or other defects that would make it unfit for further service. Replace all studs that are stripped or otherwise damaged. Remove all filings and foreign matter that may have entered the manifold as a result of repairs.

Installation

1. If intake manifold assembly was disassembled, install coolant outlet housing, new gasket, and thermostat. Install carburetor, spacer, new gaskets, automatic choke heat tubes and thermostatic choke heater tube. Install EGR valve, using a new gasket. Coat threads with electrical conductive sealer and install water temperature sending unit.
2. Clean mating surfaces of intake manifold, cylinder heads, and cylinder block. Use a solvent such as Ford Spot Remover (B7A-19521-A) or similar degreasing agent.
3. Apply a 1/8 inch diameter bead of silicone rubber sealer (C3AZ-19562-B or equivalent) in and along the joint, the full width of the cylinder block seal mounting surface (four corners) as shown in Fig. 15.
4. Install the cylinder head to manifold gaskets and the front and rear intake manifold to cylinder block seals. Apply a 1/16 inch bead of sealer at the outer end of each intake manifold seal for the full width of the seal (Fig. 15).

NOTE: This sealer sets up within 15 minutes after application, so assembly should proceed promptly.

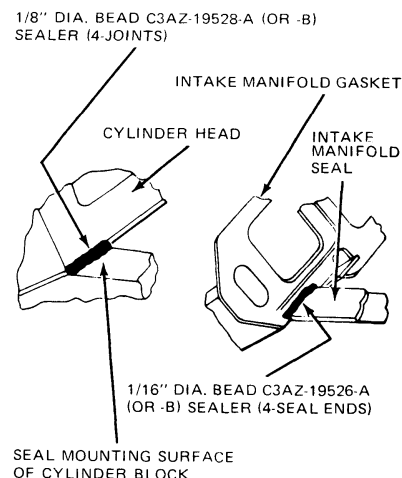


FIG. 15 Sealing Intake Manifold with RTV Sealer

5. Carefully lower intake manifold into position over four studs in ends of cylinder heads. **When intake manifold is in place, run finger around seal area to be sure seals are in place. If seals have shifted, remove manifold and re-position seals.**
6. Be sure intake manifold gaskets are properly aligned. Then install attaching bolts and nuts snugly to manifold. Tighten bolts and nuts in sequence (Fig. 16) to specifications listed at the end of this Part to compress gaskets and seals. Then repeat sequence, tightening bolts and nuts to same specifications.

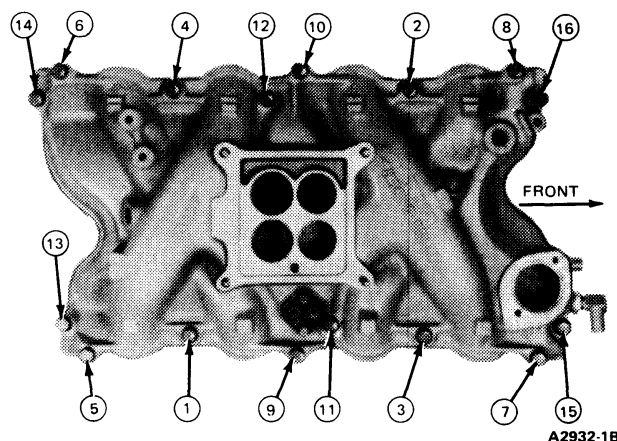


FIG. 16 Intake Manifold Torque Sequence

7. Install water pump by-pass hose to intake manifold fitting.
8. Connect radiator upper hose to coolant outlet housing.
9. Rotate crankshaft damper until No. 1 piston is at TDC at end of compression stroke. Install the

distributor following the procedure in Part 23-01 for breakerless ignition systems.

10. Connect heater hose at intake manifold and water pump.
11. Connect PCV valve and hose to right valve rocker arm cover.
12. Connect fuel line to carburetor.
13. Install coil and bracket assembly to intake manifold.
14. Fit wiring harness into three clips at inboard edge of left valve rocker arm cover and connect to all terminals.
15. Position accelerator linkage on manifold. Attach accelerator linkage bell crank. Attach speed control linkage bracket to intake manifold, if so equipped. Install linkage springs and connect linkage to carburetor.
16. Connect the vacuum lines to their respective ports at rear of intake manifold.
17. Secure distributor cap to distributor. Connect spark plug wires to spark plugs and fit wires into brackets on valve rocker arm covers. Connect coil high tension lead to coil.
18. Fill the cooling system (refer to Part 27-02, General Cooling System Service).
19. Start engine. Check and adjust ignition timing following setting listed on the engine specifications decal. Connect distributor vacuum lines to their respective parts.
20. Operate engine at fast idle and check for coolant leaks. Re-check coolant level and refill as necessary.
21. Start the engine and allow it to reach normal operating temperature, then re-tighten the manifold attaching nuts and bolts to specifications.
22. Check and adjust carburetor idle speed to specifications on engine decal. Install air cleaner and intake duct assembly.

VALVE TAPPET

The following procedure is applicable for removing one or all of the valve tappets. Before replacing a hydraulic valve tappet for noisy operation, be sure the noise is not caused by improper valve clearance or by worn rocker arms and/or push rods.

Removal

1. Remove intake manifold and carburetor as an assembly, following instructions under Intake Manifold in this Part.
2. Remove the valve rocker arm covers. Loosen the rocker arm bolts and turn rocker arms to one side (Fig. 17).
3. Remove the push rods in sequence.
4. Remove the valve tappets with a magnet. Place them in a rack in sequence. If the tappets are stuck in bores, use plier-type Tool (T70L-6500-A) or equivalent to remove them. Rotate tappets back and forth to loosen them from gum or varnish deposits.

Refer to Part 21-01 for cleaning, inspection and testing procedure. If necessary to disassemble tappet(s),

refer to Valve Tappet Disassembly and Assembly in this Part.

Installation

1. Clean the outside of valve tappets. Tappets and bores are to be lubricated with heavy oil SE before installation. Install the tappets in their original bores. Check any new tappet for free fit in bore to which it is to be installed.
2. Install push rods in original positions. Apply Lubriplate or equivalent to valve stem tips and push rod ends.
3. Position the rocker arms over the push rods and tighten the bolts following the procedure under Valve Rocker Arm Installation in this Part. Adjust valve clearance in this Part.
4. Install rocker arm covers following procedure under Rocker Arm and Cover Installation in this Part.
5. Install intake manifold and carburetor, following the instructions under Intake Manifold in this Part.

CYLINDER HEADS

Removal

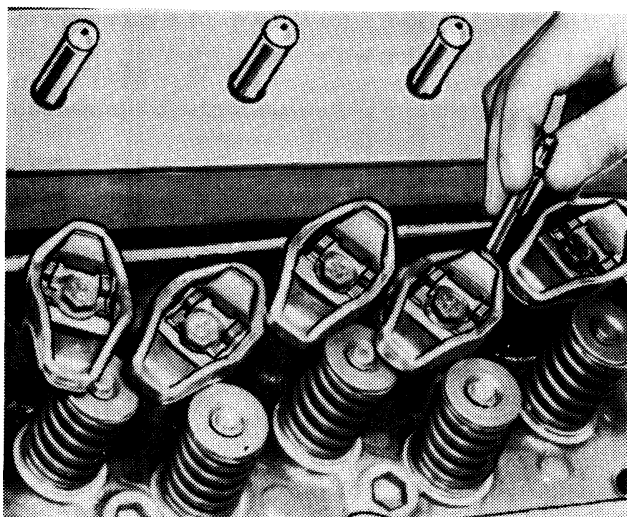
1. Remove intake manifold and carburetor as an assembly, following procedure under Intake Manifold Removal in this Part.
2. Disconnect muffler inlet pipe at exhaust manifold.
3. Loosen air conditioning compressor drive belt, if so equipped.
4. Loosen alternator attaching bolts and remove bolt attaching alternator bracket to right cylinder head.
5. If equipped with air conditioning, shut off compressor at service valves and remove valves and hoses from compressor. Remove nuts attaching compressor support bracket to water pump. Remove bolts attaching compressor to upper mounting bracket and position compressor out of way. Remove compressor upper mounting bracket from cylinder head.

If not equipped with air conditioning, remove bolts attaching power steering reservoir bracket to left cylinder head. Position reservoir and bracket out of the way.

6. Remove valve rocker arm covers. Remove rocker arm bolts, rocker arms, oil deflectors, fulcrums and push rods in sequence (Fig. 17) so they can be installed in their original positions.
7. Remove cylinder head attaching bolts. Lift cylinder heads and exhaust manifolds as assemblies from cylinder block with a hoist. **If necessary to loosen cylinder head gasket seal, pry at forward corners of cylinder heads against casting bosses provided on cylinder block. Do not damage machined surfaces of head or block. Discard cylinder head gasket.**
8. If disassembly or machining of cylinder head is required, remove exhaust manifold.

Installation

1. Clean cylinder head, intake manifold, valve rocker arm cover, and cylinder block gasket surfaces. If

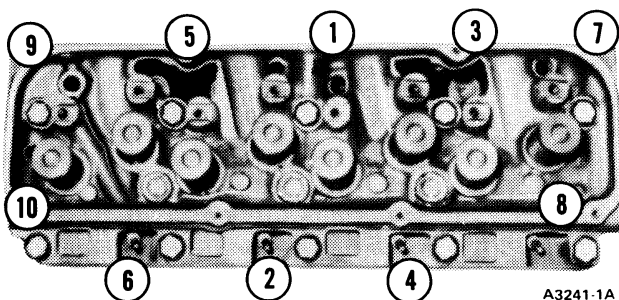


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FIG. 17 Removing Valve Push Rod

cylinder head was removed for cylinder head gasket replacement, check flatness of cylinder head and block gasket surfaces. If exhaust manifold was removed, coat cylinder head and manifold port areas with film of graphite grease and install manifold and gasket to cylinder head.

2. Place two long cylinder head attaching bolts in two rear lower bolt holes of left cylinder head. Place a long cylinder head attaching bolt in rear lower bolt hole of right cylinder head. Use rubber bands to retain bolts in position until cylinder heads are installed.
3. Position new cylinder head gaskets on block over dowels. Do not apply sealer to head gasket surfaces. Place cylinder heads on block, guiding exhaust manifold studs into muffler inlet pipe connections, and install remaining attaching bolts (longer bolts in lower row of bolt holes). Tighten all cylinder head attaching bolts in sequence (Fig. 18) in three steps: first to 108 N·m (80 ft lbs), then to 149 N·m (110 ft lbs), and finally to 177-189 N·m (130-140 ft lbs). **When this procedure is used, it is not necessary to re-tighten bolts after extended operation.**



A3241-1A

FIG. 18 Cylinder Head Bolt Torque Sequence

4. Clean and inspect push rods, one at a time. Clean the oil passage in the push rods with a suitable solvent, and blow out with compressed air.

5. Install push rods in original positions. Apply Lubriplate or equivalent to valve stem tips and push rod ends.
6. Lubricate and install the rocker arms following the procedure under Valve Rocker Arm Installation in this Part. **Be sure lower ends of push rods remain seated in valve tappets.**
7. Tighten muffler inlet pipe stud nuts to specifications (refer to Part 26-01, General Exhaust System Service).
8. Install intake manifold and carburetor assembly, following procedure under Intake Manifold Installation in this Part.
9. Perform Valve Clearance Adjustment, as detailed in this Part only if necessary.
10. If equipped with air conditioning, install compressor upper mounting bracket to left cylinder head. Attach compressor to upper mounting bracket. Attach power steering reservoir and compressor mounting bracket to left cylinder head and water pump. Connect service valves and hoses to compressor.

If not equipped with air conditioning, attach power steering reservoir bracket to left cylinder head.

11. Apply oil-resistant sealer to one side of new valve rocker arm cover gaskets. Lay cemented side of gaskets in place in covers. Install covers.
12. Install bolt attaching alternator bracket to right cylinder head. Adjust alternator drive belt tension to and tighten alternator attaching bolts to Specification listed at the end of this Part.
13. If equipped with air conditioning, adjust compressor drive belt tension to specifications listed at the end of this Part and tighten attaching bolts.
14. Fill Cooling System (refer to Part 27-02, General Cooling System Service) and power steering reservoir, as necessary.
15. Start engine and check for leaks.
16. Check and adjust carburetor idle speed to specifications on engine decal.
17. If equipped with air conditioning, evacuate compressor and partially charge system with refrigerant (refer to Part 36-30, Air Conditioning System General Service).

EXHAUST MANIFOLDS

Removal

1. If removing right exhaust manifold, remove air cleaner, intake duct assembly and heat shroud.
2. Disconnect exhaust manifold(s) at muffler inlet pipe(s).
3. Remove attaching bolts and washers, and remove exhaust manifold(s), lifting bracket(s) and spark plug wire heat shields.

Inspect the cylinder head joining flanges of the exhaust manifold(s) for evidence of exhaust gas leaks.

Inspect the manifold(s) for cracks, damaged gasket surfaces, or other defects that would make them unfit for further service.

Installation

1. Clean mating surfaces of exhaust manifold(s) and cylinder head(s). Clean mounting flange of manifold(s) and inlet pipe(s). Apply light film of graphite grease to exhaust manifold(s).
2. Position spark plug wire heat shields and exhaust manifold(s) on cylinder head(s). Install attaching bolts and washers, starting at fourth bolt hole from front of each manifold. Position lifting bracket under bolts at third exhaust port from front of engine. On right exhaust manifold, install shoulder stud(s) for air intake heat shroud at first and sixth bolt holes from front of manifold (Fig. 19). Install shoulder stud for oil indicator tube in first hole on left exhaust manifold. Tighten bolts to specifications listed at the end of this Part working from center of manifold to both ends.

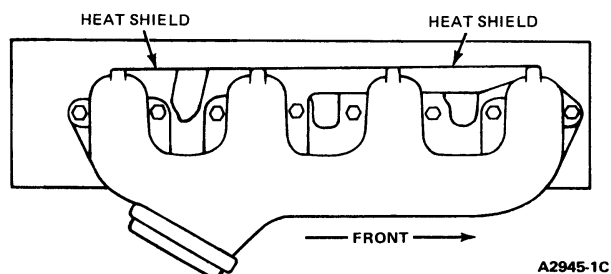


FIG. 19 Right Exhaust Manifold Installation

3. Place new gasket(s) on muffler inlet pipe(s). Position inlet pipe(s) to manifold(s). Install attaching nuts and tighten to specification. (Refer to Part 26-01.)
4. Install air cleaner and intake duct assembly, if removed.
5. Start engine and check for exhaust leaks.

WATER PUMP

Removal

1. Drain cooling system (refer to Part 27-02, General Cooling System Service) and remove the fan shroud attaching bolts.
2. Remove bolts attaching fan assembly (Fig. 7) to water pump and remove shroud and fan.
3. Loosen the power steering pump attaching bolts.
4. If vehicle is equipped with air conditioning, loosen compressor top bracket attaching bolts and remove bracket. Remove air conditioner idler arm and bracket assembly. Remove the air compressor and power steering pump drive belts.
5. If so equipped, remove air pump pulley hub bolts, and remove belt and pulley. Remove the air pump pivot bolt, disconnect by-pass hose, loosen adjustment arm and remove the air pump.
6. Loosen the alternator pivot bolt. Remove the attaching bolts and spacer. Remove the adjustment arm bolt, pivot bolt, belt and remove the alternator and bracket as an assembly.
7. Remove the power steering pump attaching bolts and position the pump to one side.
8. Disconnect the radiator lower hose and the heater hose from the water pump.

9. Loosen the by-pass hose clamp at the pump.
10. Remove remaining water pump attaching bolts and remove water pump from cylinder front cover. Remove separator plate from water pump. Discard gaskets.

Installation

1. Remove any gasket material from water pump, cylinder front cover and separator plate mating surfaces.
2. Position new gaskets coated on both sides with water-resistant sealer.
3. Position water pump on cylinder front cover. Install bolts and tighten to specifications listed at the end of this Part.
4. Connect radiator lower hose, heater return hose, and by-pass hose to water pump.
5. If so equipped, install top air conditioner compressor bracket and idler pulley assembly.
6. Position the power steering pump bracket and install the attaching bolts and the nut.
7. Rotate the alternator bracket into position and install the two attaching bolts and spacer. If so equipped, with air pump, install the alternator and air pump bracket attaching bolts. Adjust the belt tension and tighten the attaching bolts to specification listed at the end of this Part.
8. Install the air pump, adjustment arm and pulley.
9. Place the water pump pulley on the pump. Position the power steering, A/C compressor and air pump drive belts on their respective pulleys.
10. Lower the fan and radiator shroud into position (Part 27-04). Install the fan (Fig. 7) attaching bolts and the shroud attaching bolts. Tighten the bolts to specification listed at the end of this Part.
11. Adjust the power steering, alternator, air pump and compressor belt tension to Specifications listed at the end of this Part.
12. Fill the cooling system (refer to Part 27-02, General Cooling System Service).
13. Start the engine and check for leaks.

CYLINDER FRONT COVER AND TIMING CHAIN

Removal

Cylinder front cover oil seal replacement is recommended whenever the cover has been removed.

1. Drain cooling system (refer to Part 27-02, General Cooling System Service) and crankcase.
2. Remove screws attaching radiator shroud to radiator. Remove bolts attaching fan to water pump shaft. Remove fan and radiator shroud.
3. Disconnect radiator upper and lower hoses at engine. Disconnect oil cooler lines at radiator.
4. Remove radiator upper support and remove radiator (refer to Part 27-04, Radiators).
5. Loosen alternator attaching bolts to relieve tension on drive belt. If equipped with air conditioning, loosen compressor idler pulley. If so equipped, remove air pump as described in the water pump

removal procedure. Remove drive belts with water pump pulley.

6. Remove bolts attaching compressor support, water pump and compressor, and remove compressor support (if so equipped).
7. Remove the crankshaft pulley from the vibration damper.
8. Remove bolt and washer attaching crankshaft damper. Remove crankshaft damper with a puller (Fig. 20). Remove Woodruff key from crankshaft.

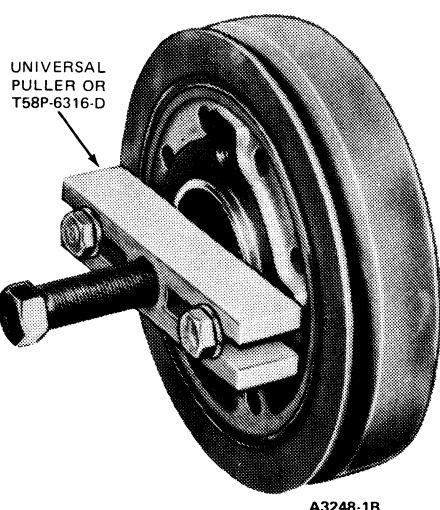


FIG. 20 Removing Crankshaft Vibration Damper

9. Loosen by-pass hose at water pump. Disconnect heater return tube at water pump.
10. Disconnect and plug fuel inlet line at fuel pump. Disconnect fuel line to carburetor at fuel pump. Remove fuel pump.
11. Remove bolts attaching cylinder front cover to cylinder block. Using a thin blade knife, cut the oil pan seal flush with cylinder block face prior to separating the cover from the cylinder block. Remove cylinder front cover and water pump as an assembly. Discard cylinder front cover gasket and oil pan seal.
12. If new cylinder front cover is to be installed, remove water pump and install it and a new gasket on the new front cover.
13. Check timing chain deflection (refer to Part 21-01) by rotating the crankshaft in a counterclockwise direction to take up the slack on the left side of the chain. (All directions are as viewed from the front of the engine).

Establish a reference point on the block and measure from this point to the left side of the chain as shown in Fig. 21. Refer to Part 21-01.

Rotate the crankshaft in the opposite direction to take up the slack on the right side of the chain. Force the left side of the chain out with the fingers and measure the distance between the reference point and the chain. The deflection is the difference between the two measurements.

If the deflection exceeds specifications, replace the timing chain and sprockets.

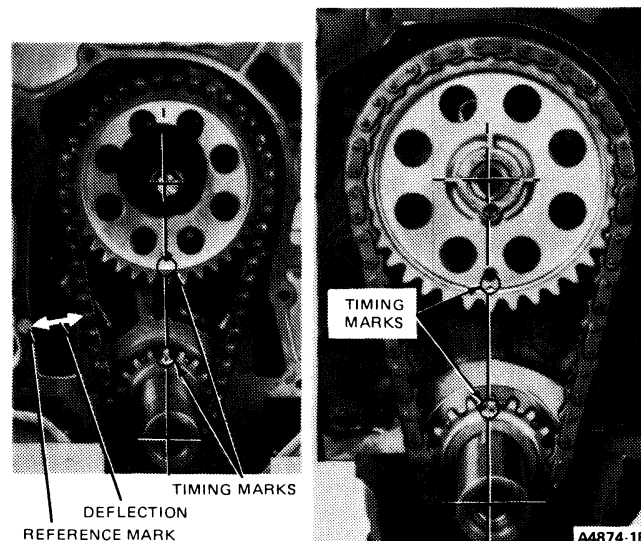


FIG. 21 Timing Chain Deflection

14. If the timing chain and sprocket are to be removed, crank the engine until timing marks on sprockets are as shown in Fig. 21.
15. Remove camshaft sprocket capscrew, washer, two piece fuel pump eccentric and front oil slinger. Slide timing chain and sprockets forward, and remove as an assembly (Fig. 22).

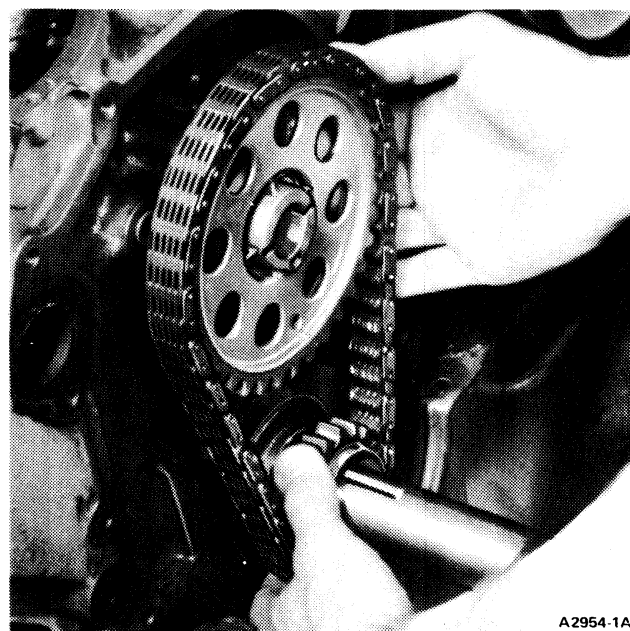


FIG. 22 Removing or Installing Timing Chain

Refer to Part 21-01 for cleaning and inspection procedures.

Installation

1. Assemble the timing chain and sprockets so sprocket timing marks point directly toward each other as shown in Fig. 21. Install the chain and sprockets as an assembly to crankshaft and camshaft. Verify proper alignment of timing marks after installation. Install front oil slinger.

2. Install the fuel pump eccentric, camshaft sprocket capscrew and washer. Tighten capscrew to specifications listed at the end of this Part. Lubricate timing chain with engine oil.
3. Coat the gasket surface of the oil pan with sealer. Cut and position the required sections of a new seal on the oil pan. Apply sealer at the corners.
4. If required, replace front oil seal as described in this Part.
5. Coat the gasket surfaces of the block and cover with sealer, and position a new gasket on the block.
6. Position the cylinder front cover on the cylinder block. Use care when installing the cover to avoid seal damage or possible mislocation.
7. Install the cylinder front cover to seal alignment tool into proper position (Fig. 23). It may be necessary to force the cover downward in a manner to slightly compress the pan seal. This operation can be facilitated by using a suitable tool at the attaching bolt hole locations.
8. Coat the threads of the attaching bolts with oil-resistant sealer and install the screws.
9. While pushing in on the alignment tool (Fig. 23) tighten the oil pan to cover attaching bolts to specifications listed at the end of this Part. Remove alignment tool. Tighten the cover to cylinder block attaching screws.

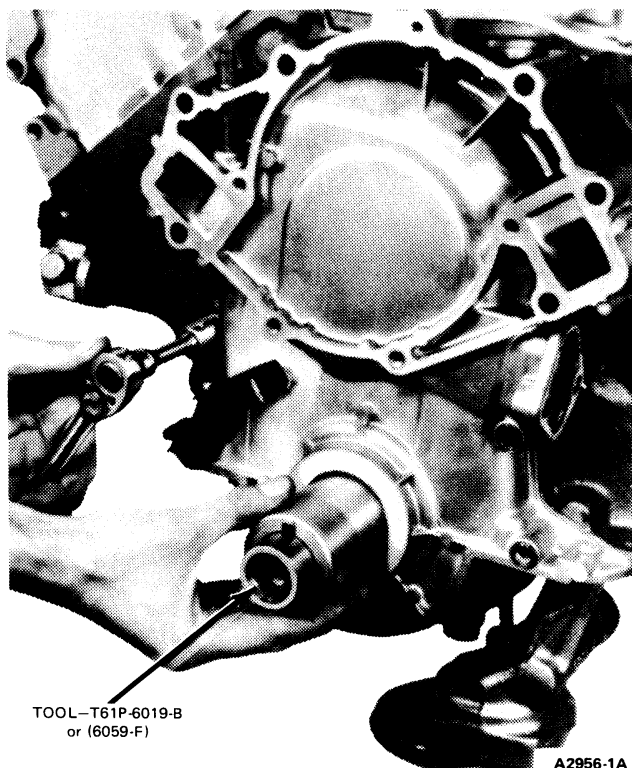


FIG. 23 Aligning Cylinder Front Cover

10. Apply white lead and oil mixture, lubriplate or equivalent to front of crankshaft for damper installation.
11. Position crankshaft damper Woodruff key and install crankshaft damper (Fig. 24). Install damper

attaching screw and washer. Tighten to specification listed at the end of this Part.

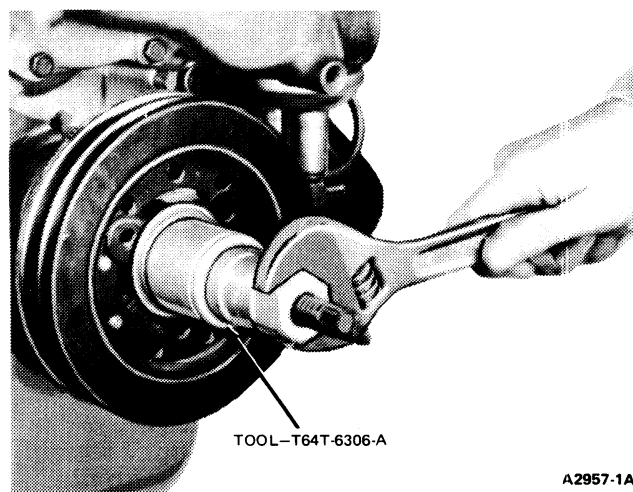


FIG. 24 Installing Crankshaft Vibration Damper

12. Install the crankshaft pulley.
13. Coat new fuel pump gasket with oil-resistant sealer and place on fuel pump. Install fuel pump. Connect fuel lines to fuel pump.
14. Install compressor support bracket to compressor and water pump, if so equipped.
15. Install water pump pulley and all drive belts.
16. Adjust belt tension to specifications listed at the end of this Part. Tighten alternator attaching bolts and compressor idler pulley, if so equipped.
17. Position radiator to lower support, position upper support to radiator, and install attaching bolts. Connect radiator upper and lower hoses at engine. Connect oil cooler lines (refer to Part 27-04, Radiators).
18. Place fan assembly inside radiator shroud and set in position in vehicle. Position the fan on the water pump and install and tighten the attaching bolts (Fig. 7). Install screws attaching shroud to radiator.
19. If any of the coolant entered the oil pan when separating the cylinder front cover from the block, the crankcase oil should be drained and refilled with the proper grade and quantity of engine oil before starting the engine.
20. Fill and bleed the cooling system (refer to Part 27-02, General Cooling System Service). Fill the crankcase to the correct level with the recommended oil.
21. Run engine at fast idle and check for coolant and oil leaks. Adjust ignition timing settings to specification on the engine decal and curb the idle speed.

FRONT OIL SEAL

Removal

Replacement of the front oil seal is recommended whenever the cylinder front cover is removed.

1. Drive out the old seal with a pin punch. Clean the seal recess in the cylinder front cover.

Installation

1. Coat a new seal with grease. Install the seal with Tool T68T-6700-A or equivalent (Fig. 25). **After installation, be sure seal spring remains in proper position.**

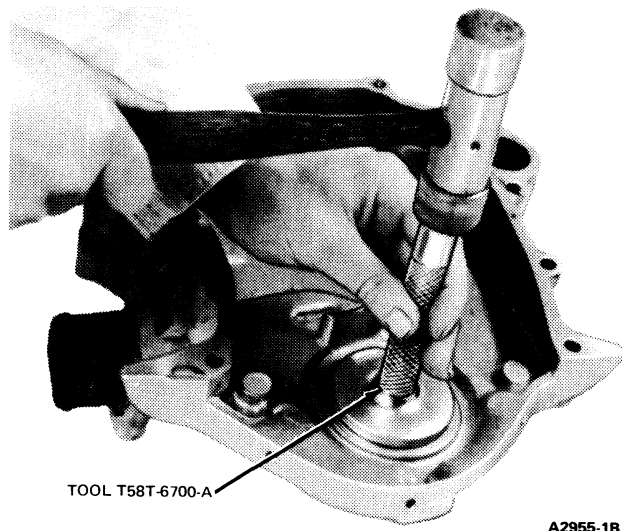


FIG. 25 Installing Front Oil Seal

CAMSHAFT

The camshaft and related parts are shown in Fig. 26.

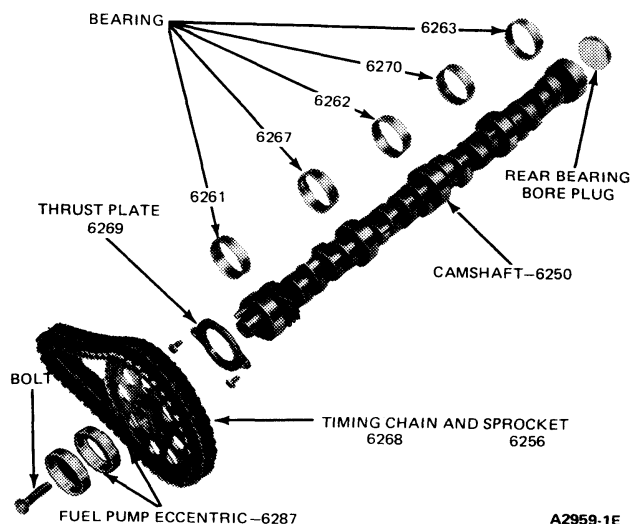


FIG. 26 Camshaft and Related Parts

Removal

1. Remove timing chain and sprockets, following procedure under Cylinder Front Cover and Timing Chain in this Part. Check timing chain deflection (refer to Part 21-01) before removal.
2. Remove the intake manifold and carburetor as an assembly, following the instructions under Intake Manifold in this Part.
3. Remove valve rocker arm covers. Back off all rocker arm bolts turn rocker arms sideways, and remove the push rods in sequence (Fig. 17).
4. Remove the valve tappets with a magnet and place them in a rack in sequence. If the tappets are stuck in bores, use plier-type Tool (T70L-6500-A) or

equivalent to remove them. Rotate the tappets back and forth to loosen it from gum or varnish deposits.

5. Remove the bolts attaching the air conditioning condenser to the chassis, if so equipped, and carefully move the condenser to rest on the left fender. Secure it in this position.
6. Remove the grille.
7. Remove the camshaft thrust plate attaching bolts, and carefully remove the camshaft from the front of engine. **Do not damage the camshaft bearings.**

Refer to Part 21-01 for cleaning and inspection procedures.

Refer to Part 21-01 for repair procedure.

Installation

1. Oil the camshaft journals and apply Lubriplate or equivalent to the cam lobes. Carefully slide camshaft into position.
2. Install camshaft thrust plate. Check camshaft end play, following procedure in Part 21-01. If end play is excessive, replace the camshaft thrust plate.
3. Install timing chain, sprockets oil slinger and cylinder front cover as detailed under, Cylinder Front Cover and Timing Chain in this Part.
4. Position the radiator in the vehicle and install the radiator upper support to secure radiator (refer to Part 27-04, Radiators). Connect the radiator lower hose and oil cooler lines.
5. Install the grille center support and air conditioning condenser (refer to Group 36), if so equipped.
6. Clean the tappets externally. Lubricate the tappets and tappet bores with heavy oil SE before installing them. Lubricate the push rod ends with Lubriplate or equivalent. Install the valve tappets and push rods in their original positions.
7. Install intake manifold and carburetor, following the procedure under Intake Manifold in this Part.
8. Rotate the crankshaft damper until No. 1 piston is at TDC at the end of compression stroke. Install the distributor following the procedure in Part 23-02 for breakerless ignition systems.
9. Apply Lubriplate or equivalent to valve stem tips. Position rocker arms over push rods and tighten bolts following the procedure under Valve Rocker Arm Installation in this Part. Adjust valve clearance if necessary following adjustments Procedures in this Part.
10. Clean the valve rocker arm covers and cylinder head gasket surfaces. Apply oil-resistant sealer to one side of the new cover gaskets. Lay the cemented side of gaskets in place in the covers.
11. Position the covers on the cylinder heads and make sure that gaskets seat evenly. Install cover attaching bolts and tighten to specifications listed at the end of this Part. Two minutes later, tighten bolts to same specifications.
12. Connect the radiator upper hose. Connect heater hose at intake manifold and at water pump.
13. Connect the fuel line to carburetor.
14. Install the coil and bracket assembly to intake manifold.

15. Install the accelerator linkage. Install the speed control linkage, if so equipped.
16. Engage engine wiring harness in clips on left cylinder head and connect all wire terminals. Connect engine vacuum lines to their original outlets on the fitting at rear of the intake manifold. Connect PCV valve and hose to right valve rocker arm cover.
17. Install the distributor cap and connect the coil and spark plug wires.
18. Place the fan assembly in the radiator shroud and set in position. Position the fan assembly to water pump shaft and install and tighten the attaching screws to specification. Install screws attaching shroud to the radiator.
19. Place the water pump pulley and drive belts in position. Adjust the tension of drive belts to specifications listed at the end of this Part and tighten attaching screws.
20. Fill and bleed the cooling system (refer to Part 27-02, General Cooling System Service) and power steering reservoir. Run engine at fast idle and check for leaks.
21. Adjust the ignition timing to specifications on the engine decal and connect distributor vacuum line.
22. Check and adjust the carburetor idle speed as required after engine temperature has stabilized. Adjust transmission linkage, if necessary (refer to Group 16 or 17). Install the air cleaner and intake duct.

FLYWHEEL

Removal

1. Remove the transmission from vehicle (refer to Group 16 or 17). Remove the mounting bolts and remove flywheel from the crankshaft.

Refer to Part 21-01, for inspection.

Installation

Install flywheel on crankshaft. Install the mounting bolts and tighten to specifications listed at the end of this Part.

1. Check flywheel runout (Fig. 27) and ring gear runout following procedure in Part 21-01. See Specifications at the end of this Part.
2. Install transmission assembly in vehicle (refer to Group 16 or 17).

CAMSHAFT REAR BEARING BORE PLUG

Removal

1. Remove the transmission from the vehicle as detailed in Group 16 or 17.
2. Remove flywheel and engine rear cover plate, following procedure under Flywheel Removal in this Part.
3. Replace the plug as detailed in Part 21-01.

Installation

1. Install the engine rear cover plate and flywheel, following procedure under Flywheel Installation.

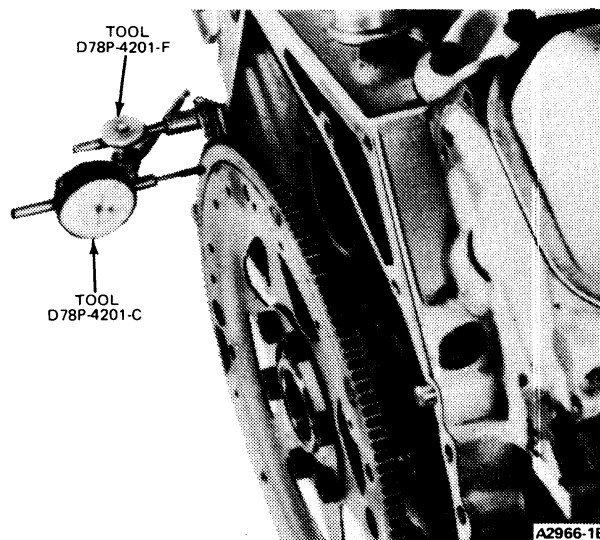


FIG. 27 Checking Flywheel Runout

2. Install the transmission as detailed in Group 16 or 17.

OIL PAN

Removal

1. Remove the engine cover, disconnect the battery, and drain the cooling system (refer to Part 27-02, General Cooling System Service).
2. Disconnect the fresh air inlet tube and remove the air cleaner assembly. Disconnect the throttle and transmission linkage at the carburetor. Disconnect the power brake vacuum line.
3. Disconnect the fuel line, choke lines, and remove the carburetor air cleaner adaptor from the carburetor.
4. Disconnect the radiator upper and lower hoses.
5. Disconnect the two oil cooler lines at the radiator, remove the fan assembly and shroud, and remove the radiator (bolts) (refer to Part 27-04, Radiators). Remove the power steering pump and position out of the way.
6. Remove the front engine mount attaching bolts and remove the engine oil dipstick tube from the exhaust manifold (one attaching bolt and one from the oil pan).
7. Remove the oil filler tube and bracket (bolt).
8. If so equipped, rotate A/C lines (at rear of compressor) down to clear the dash or remove the lines.
9. Raise the vehicle on a hoist, drain the crankcase, and remove the oil filter.
10. Remove the muffler inlet pipe assembly. Disconnect the manual and kickdown linkage from the transmission.
11. Remove the driveshaft and coupling shaft assembly. Remove the transmission tube assembly.
12. Remove the dipstick and tube from the oil pan. Place a transmission jack under the engine oil pan. Insert a wood block between the jack surface and the oil pan. Jack the engine upward, pivoting about

the rear mount until the transmission contacts the floor and block the engine in position. The engine must remain centralized to obtain the maximum height. The engine must be raised four inches at the mounts to remove the oil pan.

13. Remove the oil pan retaining bolts. Lower the oil pan. Remove the oil pump and pick-up tube attachments and drop the oil pump and pick-up tube assembly into the oil pan. Remove the oil pan rearward from the vehicle.

Installation

1. Clean the oil pan gasket surface at the cylinder block. Clean the oil pan assembly, the oil pump pick-up tube, and the screen.
2. Position the oil pan gaskets and end seals to the cylinder block using sealer. Position the oil pan with oil pump and pick-up tube assembly to the chassis and install the oil pump assembly to the cylinder block.
3. Position the oil pan to the cylinder block and install the attaching bolts.
4. Place jack under engine and raise engine enough to remove block.
5. Lower engine and remove jack.
6. Position the engine oil dipstick tube to the oil pan and install the attaching nut.
7. Re-position the A/C lines, if so equipped.
8. Install the engine support-to-bracket attaching bolts and connect the manual and kick-down linkage at the transmission. Install the drive shaft and coupling shaft assembly, and the muffler inlet pipe assembly.
9. Clean the oil filter mounting surface and install the oil filter.
10. Lower the vehicle from the hoist. Install the engine oil filler tube and bracket (one bolt). Attach the oil dipstick tube to the left exhaust manifold (one nut).
11. Install the radiator assembly and connect the two oil cooler lines (refer to Part 27-04, Radiators).
12. Install the fan assembly and shroud, and then connect the lower and upper radiator hoses.
13. Install the air cleaner adaptor and fuel line.
14. Connect the throttle and transmission linkage at the carburetor.
15. Re-position the power steering pump belt. Install the transmission filler tube to the right cylinder head (two bolts).
16. Install the air cleaner assembly and fresh air inlet tube, fill the cooling system (refer to Part 27-02, General Cooling System Service). connect the battery and fill the crankcase. Start the engine and check for leaks. Install the engine cover.

OIL PUMP

Remove and install the oil pump as described under Oil Pan Removal and Installation. The oil pump and oil pan must be removed together.

CRANKSHAFT REAR OIL SEAL

Replacement of a crankshaft rear oil seal because of oil leakage requires replacement of upper and lower seals as detailed in Part 21-01.

MAIN BEARING

Main and connecting rod bearing inserts are selective fits.

Selective fit bearings are available for service in standard size, 0.001 and 0.002 inch undersize. Undersize bearings, (0.010, 0.020, 0.030 and 0.040 inch) which are not selective fit, are available for use on crankshaft journals that have been refinished.

Removal

1. Drain the crankcase. Remove the oil level dipstick. Remove the oil pan, oil pump and related parts, following the procedure under Oil Pan Removal in this Part.
2. Replace one bearing at a time, leaving other bearings securely fastened. Remove the main bearing cap to which new bearings are to be installed.
3. Insert the upper bearing removal tool (Tool 6331-E) or equivalent in oil hole in crankshaft (Fig. 28).

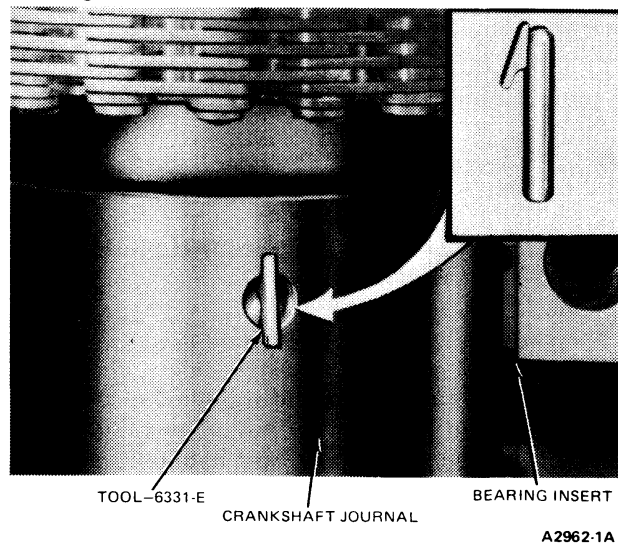


FIG. 28 Removing or Installing Upper Main Bearing Insert

4. Rotate the crankshaft in the direction of engine rotation to force bearing out of block.
5. Clean the crankshaft journals. Inspect journals and thrust faces (thrust bearing) for nicks, burrs or bearing pickup that would cause premature bearing wear.

Installation

1. To install upper main bearing, place plain end of bearing over shaft on locking tang side of block and partially install bearing so Tool 6331-E or equivalent can be inserted in oil hole in crankshaft (Fig. 28). With Tool 6331-E or equivalent in oil hole,

rotate the crankshaft in the opposite direction of engine rotation until the bearing seats itself. Remove the tool.

2. Fit the main bearings as detailed in Part 21-01 under Fitting Bearings with Plastigage or equivalent.
3. After the bearing has been fitted, apply light coat of engine oil to journal and bearings. Install the bearing cap. Tighten the cap bolts to specifications listed at the end of this Part.
4. Repeat the procedure for remaining bearings that require replacement.
5. If the rear main bearing is to be replaced, remove the rear main bearing cap. Remove and discard the rear oil seal.
6. Clean rear journal oil seal groove and mating surfaces of block and rear main bearing cap.
7. Install the new seal as shown in Fig. 29.

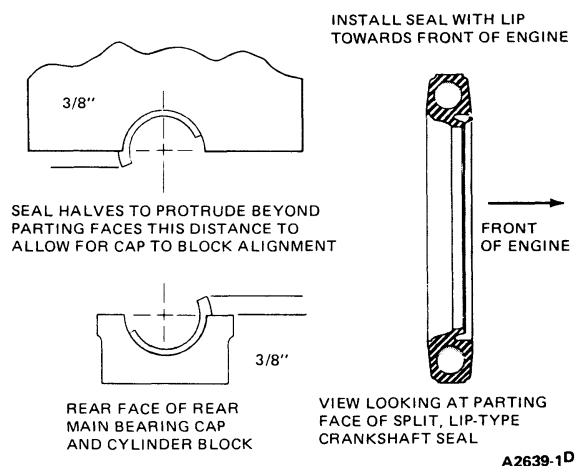


FIG. 29 Crankshaft Rear Oil Seal Installation

8. Refer to Part 21-01 for procedure used in sealing the rear main bearing cap. After sealing, install the rear main bearing cap and tighten cap bolts to specifications listed at the end of this Part.
9. If thrust bearing cap (No. 3 main bearing) has been removed, install as follows:

Install the thrust bearing cap with bolts finger-tight. Pry the crankshaft forward against the thrust surface of upper half of bearing (Fig. 30). Hold the crankshaft forward and pry thrust bearing cap to rear. This aligns thrust surfaces of both halves of bearing. Retain forward pressure on crankshaft. Tighten cap bolts to specifications listed at the end of this Part.

10. Clean the oil pump inlet tube screen. Prime the oil pump by filling the inlet opening with oil and rotate the pump shaft until oil emerges from the outlet opening.
11. Install the oil pan and oil pump, following procedure under Oil Pan Installation in this Part.
12. Fill the crankcase. Start the engine and check for oil pressure. Operate the engine at fast idle and check for oil leaks.

CONNECTING ROD BEARING

Removal

1. Follow Steps 1 and 2 under Main Bearing Removal in this Part.
2. Turn the crankshaft until connecting rod to which new bearings are to be fitted is down. Remove the connecting rod cap. Remove the bearing inserts from rod and cap.
3. Be sure the bearing inserts and bearing bore in connecting rod and cap are clean. Foreign material under inserts will distort bearing and cause a failure.
4. Clean the crankshaft journal. When replacing standard bearings with new bearings, it is good practice to fit the bearing to minimum specified clearance listed at the end of this Part.

Installation

Refer to Part 21-01 for cleaning and inspection procedures.

1. Fit connecting rod bearings as detailed in Part 21-01 under Fitting Bearings with Plastigage.
2. Install the bearing inserts in the connecting rod and cap with tangs in the slots provided.
3. Pull the connecting rod assembly down firmly on the crankshaft journal.
4. Apply a light coat of engine oil to the journal and bearings. Install the connecting rod cap. Be sure the connecting rod bolt heads are properly seated in the connecting rod. Tighten the nuts to specifications listed at the end of this Part.
5. Repeat the procedure for the remaining connecting rods that require new bearings.
6. To complete installation, follow instructions under Main Bearing Installation in this Part.

PISTONS AND CONNECTING RODS

Removal

1. Drain the cooling system (refer to Part 27-02, General Cooling System Service) and crankcase. Remove the intake manifold, cylinder heads, oil pan and oil pump, following procedures in this Part.
2. Remove any ridge and/or deposits from upper end of cylinder bores as follows:

Turn the crankshaft until the piston to be removed is at bottom of its travel. Place a cloth on top of the piston to collect cuttings. Remove any ridge and/or deposits from the upper end of the cylinder bore. Remove the cylinder ridge with a ridge cutter. Follow instructions furnished by tool manufacturer. **Never cut into ring travel area in excess of 1/32 inch when removing ridges.** Repeat the procedure at the remaining cylinders.

3. Make sure that all connecting rod caps are marked so they can be installed in their original positions.
4. Turn the crankshaft until the connecting rod being removed is down.
5. Remove the connecting rod nuts and cap.
6. Push the connecting rod and piston assembly out through the top of the cylinder with the handle end of a hammer. **Avoid damage to the crankshaft**

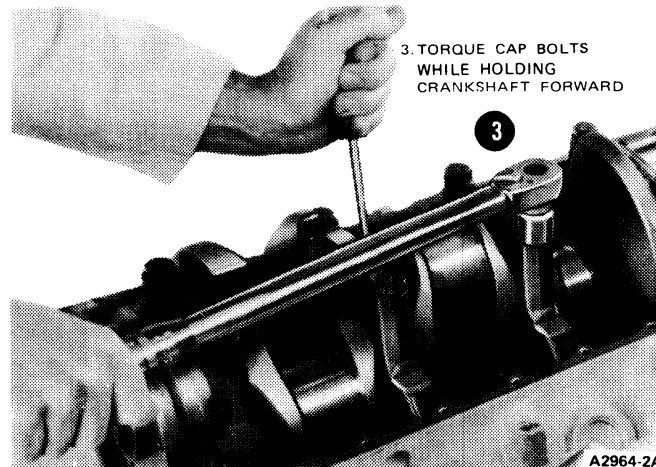
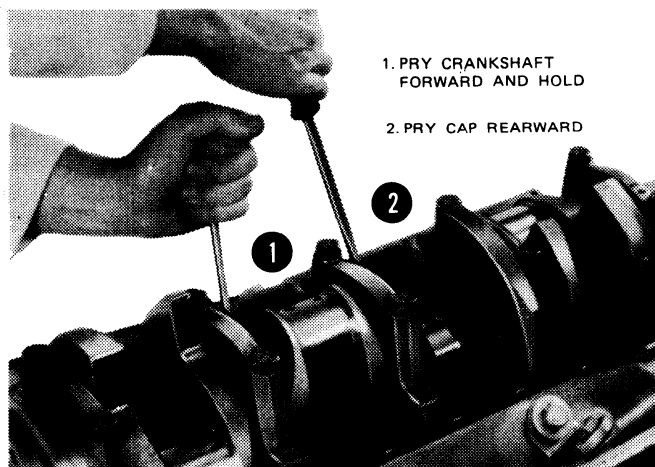


FIG. 30 Aligning Thrust Bearing

journal and cylinder wall when removing the piston and rod.

7. Remove the bearing inserts from the connecting rod and cap.
8. Install the cap on the connecting rod from which it was removed.

Installation

1. If new piston rings are to be installed, remove the cylinder wall glaze. Follow instructions as detailed in Part 21-01. Clean cylinder bores with soap and water after honing or deglazing. Dry and oil immediately after cleaning.
2. Oil the piston rings, pistons and cylinder walls with light engine oil. **Be sure to install pistons in the same cylinders from which they were removed or to which they were fitted. Connecting rod and bearing caps are numbered from 1 to 4 in the right bank, and 5 to 8 in the left bank, beginning at the front of engine. Numbers on the connecting rod and bearing cap must be on the same side when installed in the cylinder bore. If a connecting rod is ever transposed from one block or cylinder to another, new bearings should be fitted and the connecting rod should be numbered to correspond with the new cylinder number.**
3. Make sure that ring gaps (oil ring spacer A, oil ring segments B, and compression ring C) are properly spaced around circumference of piston (Fig. 31).
4. Install piston ring compressor on piston and push in with hammer handle until it is slightly below top of cylinder (Fig. 32). Be sure to guide connecting rods while tapping them into position to avoid damaging crankshaft journals. **Install piston with indentation notch in piston head toward front of engine.**
5. Check clearance of each bearing, following procedure under Fitting Connecting Rod Bearings, Part 21-01.
6. After the bearings have been fitted, apply a light coat of engine oil to the journals and bearings.

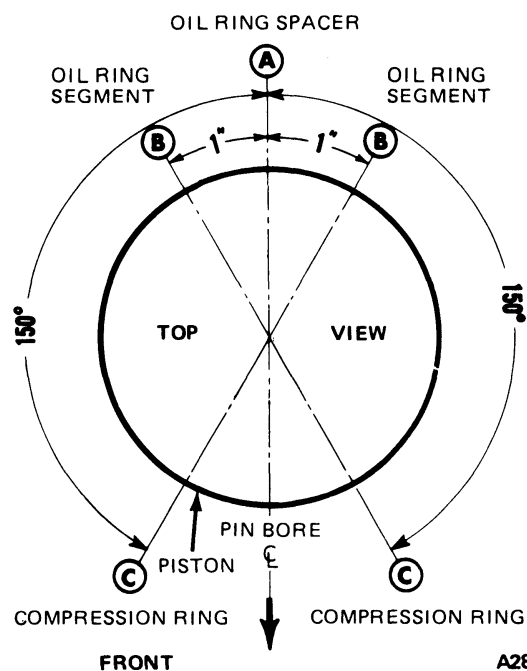


FIG. 31 Piston Ring Spacing

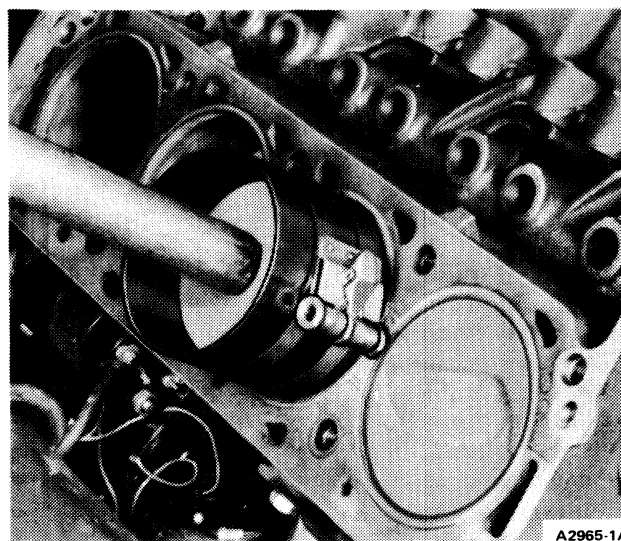


FIG. 32 Installing Piston Assembly

7. Turn the crankshaft throw to the bottom of the stroke. Push the piston all the way down until the connecting rod bearings seats on the crankshaft journal.
8. Install the connecting rod cap. Be sure connecting rod bolt heads are properly seated in the connecting rod. Tighten the nuts to specifications listed at the end of this Part.
9. After the piston and connecting rod assemblies have been installed, check the side clearance between the connecting rods on each crankshaft journal (Part 21-01).
10. Disassemble, clean and assemble the oil pump. Clean the oil pump inlet tube screen, and oil pan and the block gasket surfaces.
11. Prime the oil pump by filling the inlet port with engine oil and rotating the pump shaft to distribute oil within the housing. Install the oil pump and the oil pan, following the procedure under Oil Pan Installation in this Part.
12. Install the cylinder heads, following instructions under Cylinder Head Installation in this Part.
13. Install the intake manifold, following instructions under Intake Manifold Installation in this Part.
14. Fill and bleed the cooling system (refer to Part 27-02, General Cooling System Service). Fill the crankcase to the correct level with the specified engine oil.
15. Start the engine and adjust the ignition timing to specifications on the engine decal. Connect the distributor vacuum line.
16. Operate the engine at fast idle and check for oil and coolant leaks. With the engine temperatures stabilized, adjust the engine curb idle speed.
17. Install the air cleaner and intake duct assembly.

CRANKSHAFT

To perform following operation, it is necessary to remove the engine and install it on a work stand.

Crankshaft and related parts are shown in Fig. 33.

Removal

1. Disconnect the wires from the spark plugs using Tool T74P-6666-A or equivalent. Remove the spark plugs to allow easy rotation of crankshaft.
2. Remove the fuel pump and the oil filter. Slide water pump by-pass hose clamp toward the water pump.
3. Remove the crankshaft pulley from the vibration damper.
4. Remove the capscrew and washer from the end of the crankshaft. Install a puller on the crankshaft vibration damper (Fig. 20) and remove damper. Remove Woodruff key.
5. Remove the cylinder front cover and water pump as an assembly. Check the timing chain deflection (refer to Part 21-01). Remove the timing chain and sprockets as detailed in Under Cylinder Front Cover and Timing Chain Removal in this Part.
6. Invert the engine on a work stand. Remove the flywheel and the engine rear cover plate. Remove the oil pan and gasket. Remove the oil pump.

7. Make sure that all bearing caps, (main and connecting rod), are marked so they can be installed in their original locations.

Turn the crankshaft until the connecting rod from which cap is being removed is down, then remove the bearing cap. Push the connecting rod and piston assembly up into the cylinder. Repeat this procedure until all connecting rod bearing caps are removed.

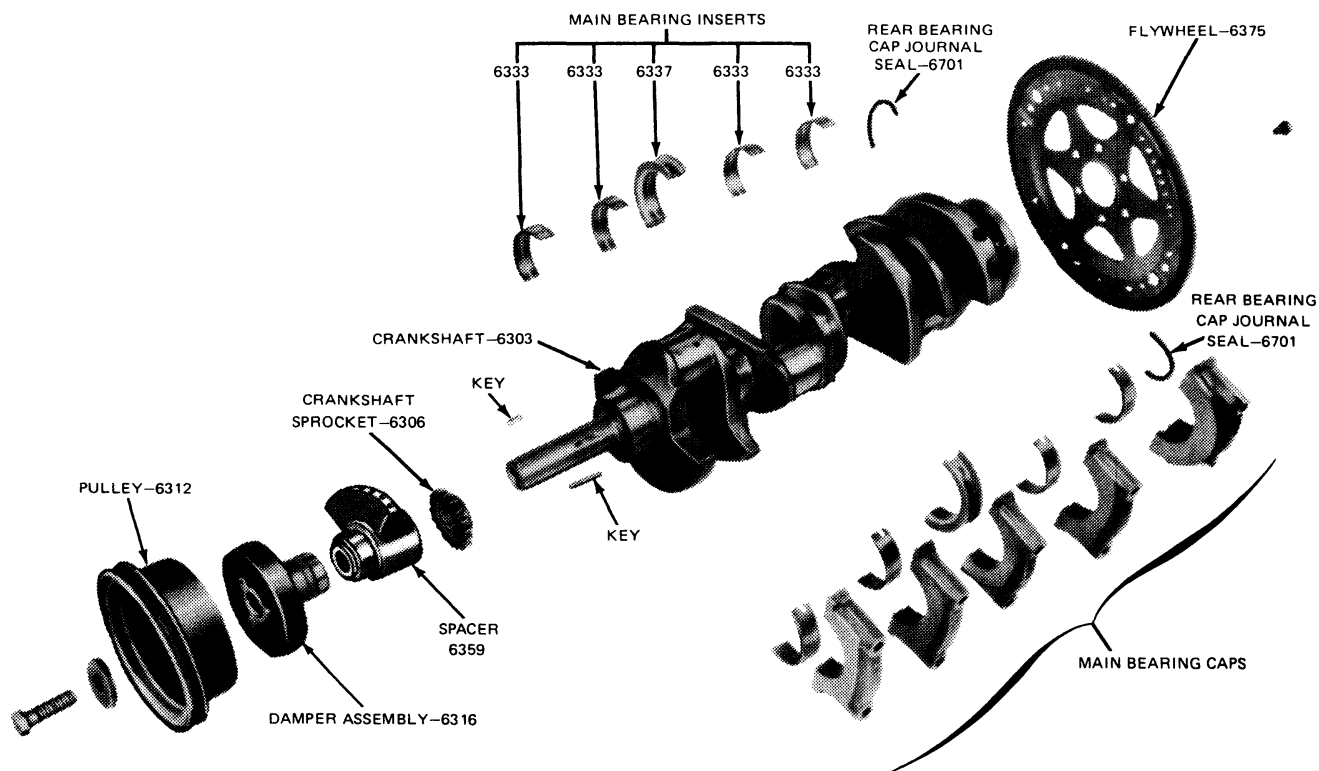
8. Remove the main bearing caps.
9. Carefully lift the crankshaft out of the block so thrust bearing surfaces are not damaged. **Handle the crankshaft with care to avoid possible fracture or damage to finished surfaces.**

Refer to Part 21-01 for cleaning and inspection procedures. Clean the crankshaft damper.

To refinish journals, dress minor imperfections, etc., refer to Part 21-01.

Installation

1. Remove the rear journal oil seal from block and rear main bearing cap.
2. Remove the main bearing inserts from the block and bearing caps (Fig. 33).
3. Remove the connecting rod bearing inserts from the connecting rods and caps.
4. If the crankshaft main bearing journals have been refinished to a definite undersize, install the correct undersize bearing. Be sure that bearing inserts and bearing bores are clean. Foreign material under inserts will distort the bearing and cause failure.
5. Place the upper main bearing inserts in the bores with tang in slot. **CAUTION: THE OIL HOLES IN THE BEARING INSERTS MUST BE ALIGNED WITH THE OIL HOLES IN THE CYLINDER BLOCK.**
6. Install lower main bearing inserts in bearing caps.
7. Clean the rear journal oil seal groove and mating surfaces of the block and rear main bearing cap.
8. Install a new rear main bearing oil seal in the block and cap as detailed in Part 21-01.
9. Carefully lower the crankshaft into place. **Be careful not to damage bearing surfaces.**
10. Check the clearance of each main bearing as detailed in Part 21-01.
11. After bearings have been fitted, apply light coat of engine oil to journals and bearings. Install a new seal in the rear main bearing cap and install the rear main bearing cap. Install all bearing caps except thrust bearing cap (No. 3 bearing). **Be sure that main bearing caps are installed in original locations.** Tighten the bearing cap bolts to specifications listed at the end of this Part.
12. Install the thrust bearing cap with bolts fingertight.
13. Pry the crankshaft forward against thrust surface of upper half of bearing (Fig. 30).
14. Hold crankshaft forward and pry thrust bearing cap to rear. This aligns thrust surfaces of both halves of bearing.
15. Retain forward pressure on the crankshaft. Tighten cap bolts to specifications listed at the end of this Part.



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FIG. 33 Crankshaft and Related Parts

16. Force the crankshaft toward the rear of engine.
17. Check the crankshaft end play (refer to Part 21-01).
18. Install new bearing inserts in the connecting rods and caps. Check clearance of each bearing, following procedure detailed in Part 21-01 (refer to Specifications listed at the end of this Part). Fitting Bearings with Plastigage.
19. After the connecting rod bearings have been fitted, apply light coat of engine oil to journals and bearings.
20. Turn the crankshaft throw to bottom of its stroke. Push the piston all the way down until rod bearing seats on the crankshaft journal.
21. Install the connecting rod cap. Be sure that connecting rod bolt heads are properly seated in connecting rod. Tighten nuts to specifications listed at the end of this Part.
22. After piston and connecting rod assemblies have been installed, check side clearance (refer to Specifications listed at the end of this Part) between connecting rods on each connecting rod crankshaft journal.
23. Install timing chain and sprockets, oil slinger, cylinder front cover, and crankshaft damper as detailed in Cylinder Front Cover and Timing Chain Installation in this Part.
24. Install the engine rear cover plate. Coat flywheel attaching bolt threads with oil-resistant sealer. Position flywheel on crankshaft flange. Install and tighten the bolts to specifications listed at the end of this Part.
25. Clean the oil pan, oil pump and oil pump screen. Prime the oil pump by filling inlet port with engine oil and rotating pump shaft to distribute oil within housing. Install oil pump and oil pan by following procedures under Oil Pan Installation in this Part.
26. Install the oil filter and fuel pump, and connect the fuel lines.
27. Install the spark plugs and connect the spark plug wires.
28. Install the engine in vehicle following procedures in this Part.

CAMSHAFT BEARINGS

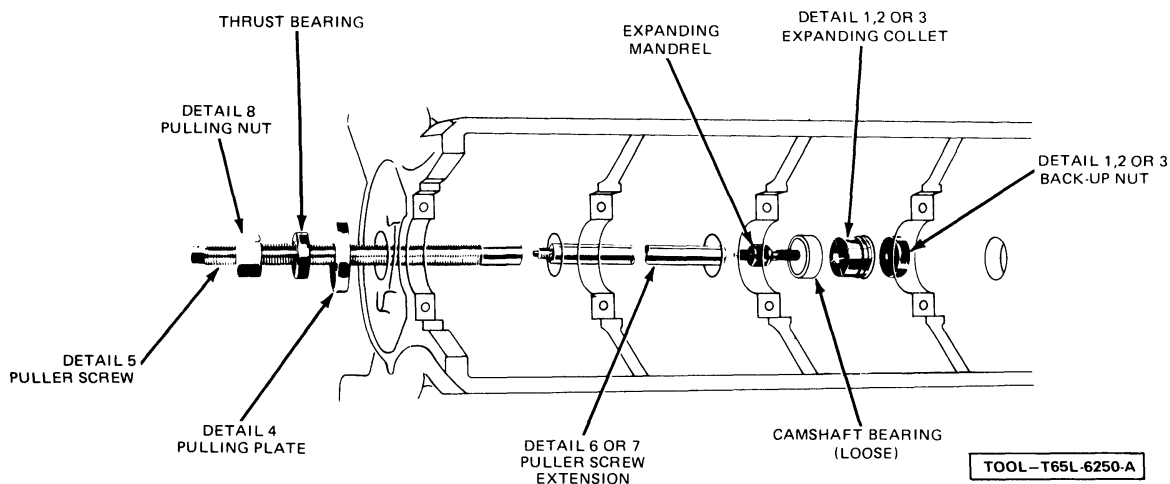
Camshaft bearings are available prefinished to size for standard and undersize journal diameters.

Removal

1. With engine removed and placed in a work stand, remove the camshaft, flywheel, and crankshaft, following the appropriate procedures in this part. Push pistons to top of cylinders.
2. Remove the camshaft rear bearing bore plug as detailed in Part 21-01. Remove camshaft bearings (Fig. 34).

Installation

1. Select the proper size expanding collet and back-up nut and assemble on expanding mandrel. With the expanding collet collapsed, install the collet in the camshaft bearing, and tighten back-up nut on expanding mandrel until collet fits camshaft bearing.



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FIG. 34 Replacing Camshaft Bearing

2. Assemble the puller screw and extension (if necessary) as shown in Fig. 34 and install on expanding mandrel. Wrap a cloth around threads of the puller screw to protect the front bearing or journal. Tighten pulling nut against the thrust bearing and pulling plate to remove camshaft bearing. Hold a wrench on the end of puller screw to prevent it from turning.
3. Repeat the procedure for each bearing. To remove the front bearing, install puller screw from rear of cylinder block.
4. Position new bearings at bearing bores, and press in place with the tool shown in Fig. 34. Be sure to center the pulling plate and puller screw to avoid bearing damage. **Failure to use correct expanding collet can cause severe bearing damage.** Align oil holes in bearings with oil holes in cylinder block before pressing them into block. Be sure front bearing is installed specified distance below front face of cylinder block (Fig. 35).



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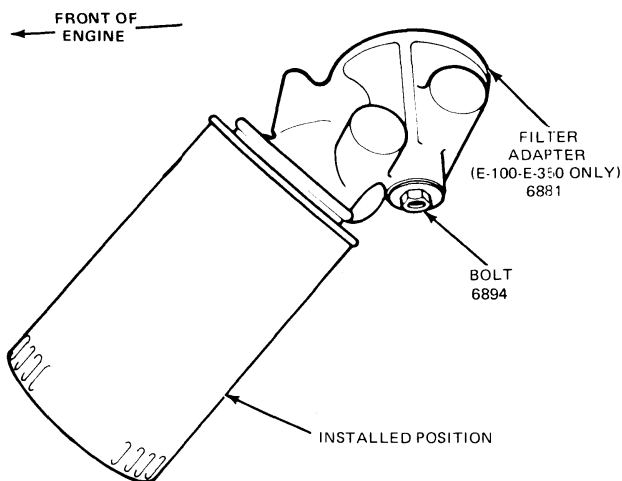
FIG. 35 Measuring Depth of Camshaft Front Bearing

5. Install the core plug as detailed in Part 21-01.
6. Install the camshaft, crankshaft, flywheel and related parts, following appropriate procedures in this part, except do not check connecting rod and main bearing clearances.

OIL FILTER

Removal

The oil filter and adaptor assembly is shown in Fig 36.



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FIG. 36 Oil Filter

1. Place a drip pan under the filter. Unscrew the filter from the adapter fitting using an oil filter wrench and clean the adapter recess. Clean the oil filter gasket surface.

Installation

1. Coat the gasket on a new filter with oil. Place a new filter on the adapter fitting. Hand tighten the filter until the gasket contacts the sealing surface then tighten one-half turn more.

2. Operate the engine at fast idle and check for oil leaks. If oil leaks are evident, perform the necessary

repairs to correct the leakage. Check the oil level and fill the crankcase to the correct level.

DISASSEMBLY AND ASSEMBLY

When installing nuts or bolts that must be tightened oil the threads with light engine oil. Refer to the Specification at the end of this Part for proper Torque Values. **Do not oil threads that require oil-resistant or water-resistant sealer.**

VALVE TAPPET

Each tappet is a matched assembly. If parts of one are intermixed with those of another, improper valve operation may result. Disassemble and assemble each tappet separately. Valve tappets should be tested after assembly as described in Part 21-01. Keep the tappets assemblies in proper sequence so they can be installed in their original bores.

Disassembly

Hydraulic valve tappet assembly is shown in Fig. 37.

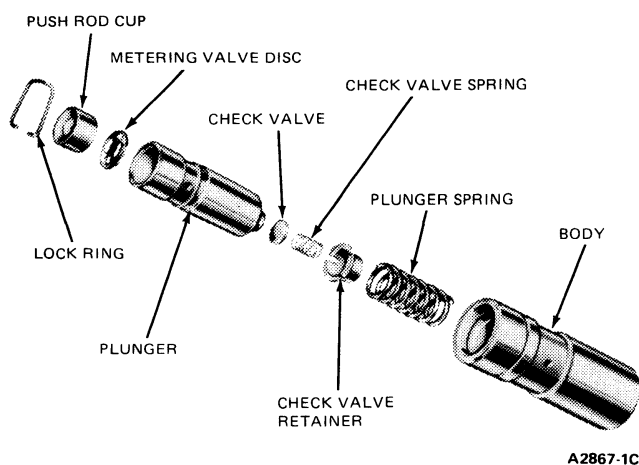


FIG. 37 Hydraulic Valve Tappet

1. Grasp the lock ring with needle nose pliers to release it from the groove. It may be necessary to depress the plunger to fully release lock ring.
2. Remove the push rod cup, metering valve (disc), plunger and spring.
3. Remove the plunger assembly and the plunger spring. Carefully remove the plunger spring, check valve retainer spring, check valve retainer and check valve disc from the plunger.

Refer to Part 21-01 for cleaning and inspection procedures.

Assembly

1. Place the plunger upside down on a clean work bench.
2. Place the check valve (disc or ball check) in position over the oil hole on the bottom of the plunger. Set the check valve spring on top of the check valve (disc or ball check).

3. Position the check valve retainer over the check valve and spring then push the retainer down into place on the plunger.
4. Place the plunger spring and the plunger (open end up) into tappet body.
5. Position the metering valve (disc) in the plunger, and place push rod seat in the plunger.
6. Depress the plunger and position the closed end of lock ring in the groove of the tappet body. With the plunger still depressed, position the open ends of lock ring in the groove. Release the plunger, and then depress it again to fully seat the lock ring.
7. Use a hydraulic valve tappet leak-down tester to fill the tappet with test fluid.

CYLINDER HEAD

Disassembly

1. With cylinder head removed from engine, remove rocker arm bolts, oil deflectors, fulcrum seats, and rocker arms. Remove exhaust manifolds and spark plugs.
2. Clean carbon from combustion chambers before removing valves.
3. Compress valve springs (Fig. 38). Remove spring retainer locks and release springs. Remove retainers, springs, stem seals, and valves. Discard stem seals.

Clean and inspect cylinder head(s) and related components, using pertinent procedures in Part 21-01.

Refer to Part 21-01 for repair procedures for cylinder heads and valves.

Assembly

Lubricate all valves, valve stems and valve guides with heavy oil SE. The valve tips are to have Lubriplate or equivalent applied. The lubricant is to be applied before installation.

1. Install each valve in port from which it was removed or to which it was fitted. Install new stem seal on each valve.
2. Set valve spring and retainer over valve stem. Compress spring (Fig. 38) and install retainer locks.
3. With dividers, measure assembled height of valve spring from surface of spring pad on cylinder head to underside of spring retainer (Fig. 39). Check dividers with accurate scale. If assembled height exceeds specification listed at the end of this Part, install spacer(s) below spring to reduce height to recommended dimension. **Reducing assembled height below specifications can cause spring breakage and rapid wear of cam lobe.**
4. Coat the fulcrum seats and sockets with Lubriplate or equivalent. Make certain that the rocker arm

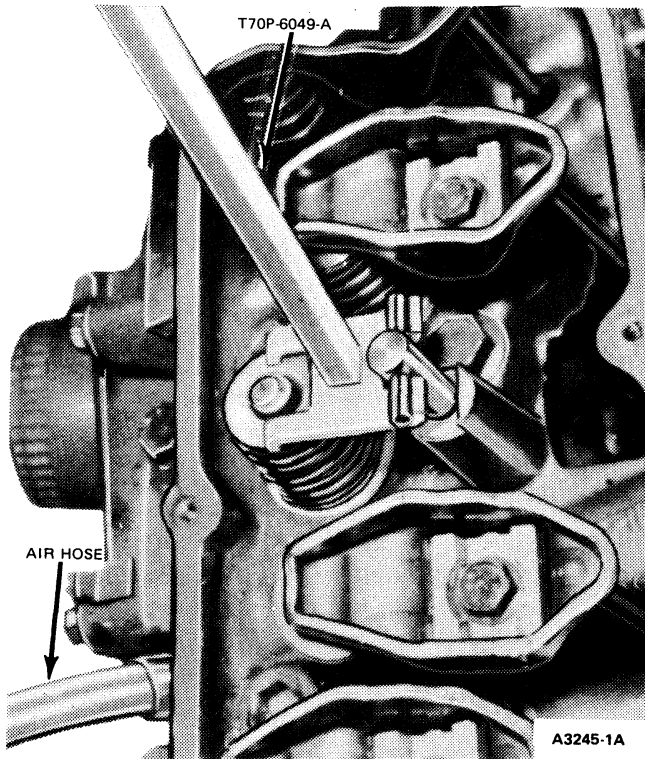


FIG. 38 Compressing Valve Spring—In Chassis

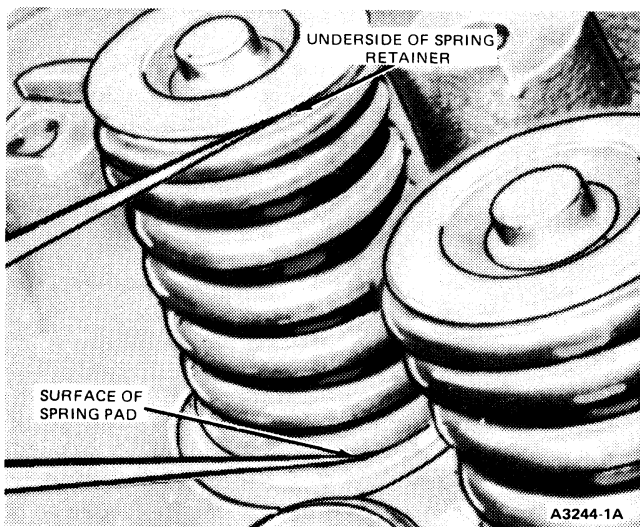


FIG. 39 Measuring Valve Spring Assembled Height

bolts are in a serviceable condition before installing them. Install rocker arms, fulcrum seats, oil deflectors and bolts as detailed under Valve Rocker Arm Installation.

5. Install exhaust manifolds (refer to Part 26-01, General Exhaust System Service) and spark plugs.

PISTON AND CONNECTING ROD

Disassembly

1. Remove the bearing inserts from the connecting rod and cap.

2. Mark the pistons to assure assembly with same rod and installation in the same cylinders from which they were removed.
3. Using an arbor press and tool shown in Fig. 40 press the piston pin from the piston and connecting rod. Remove the piston rings.

Refer to Part 21-01, for cleaning and inspection procedures.

Refer to Part 21-01, for repair procedures.

Assembly

Check the fit of a new piston in the cylinder bore before assembling piston and piston pin to connecting rod. Piston pin bore of connecting rod and diameter of piston pin must be within specifications.

1. Apply a light coat of engine oil to all parts. Assemble the piston to the connecting rod with the cylinder number side of the connecting rod and indentation notch in piston positioned as shown in Fig. 41.
2. Start the piston pin in the piston and the connecting rod. Using an arbor press, press the piston pin through the piston and connecting rod until the end of pin is 1/16-inch to 1/8 inch below chamfer of the pin bore in the piston.
3. Check the end gap of all piston rings. End gap must be within specifications. Follow the instructions contained on piston ring package and install the piston rings.
4. Check the ring side clearance of compression rings with a feeler gauge inserted between the ring and the lower land. Feeler gauge should slide freely around the ring circumference without binding. Any wear will form a step at the inner portion of the lower land. **If the lower lands have high steps, replace the piston.**
5. Be sure the bearing inserts and bearing bore in the connecting rod and cap are clean. Foreign material under the inserts will distort the bearing and cause failure. Install bearing inserts in connecting rod and cap with tangs fitting in slots provided.

CYLINDER ASSEMBLY—6009

Disassembly

1. Mount the old engine on a work stand and remove all the parts not furnished with the new cylinder assembly, following the procedures given in Removal and Installation of this Part.
2. Remove the 4 cylinder head locating dowels and the block drain plugs.
3. Remove the old cylinder assembly from the work stand.

Assembly

1. Clean the gasket and seal surfaces of all serviceable parts and assemblies.
2. Position the new cylinder assembly on a work stand and install the cylinder head locating dowels and block drain plugs.

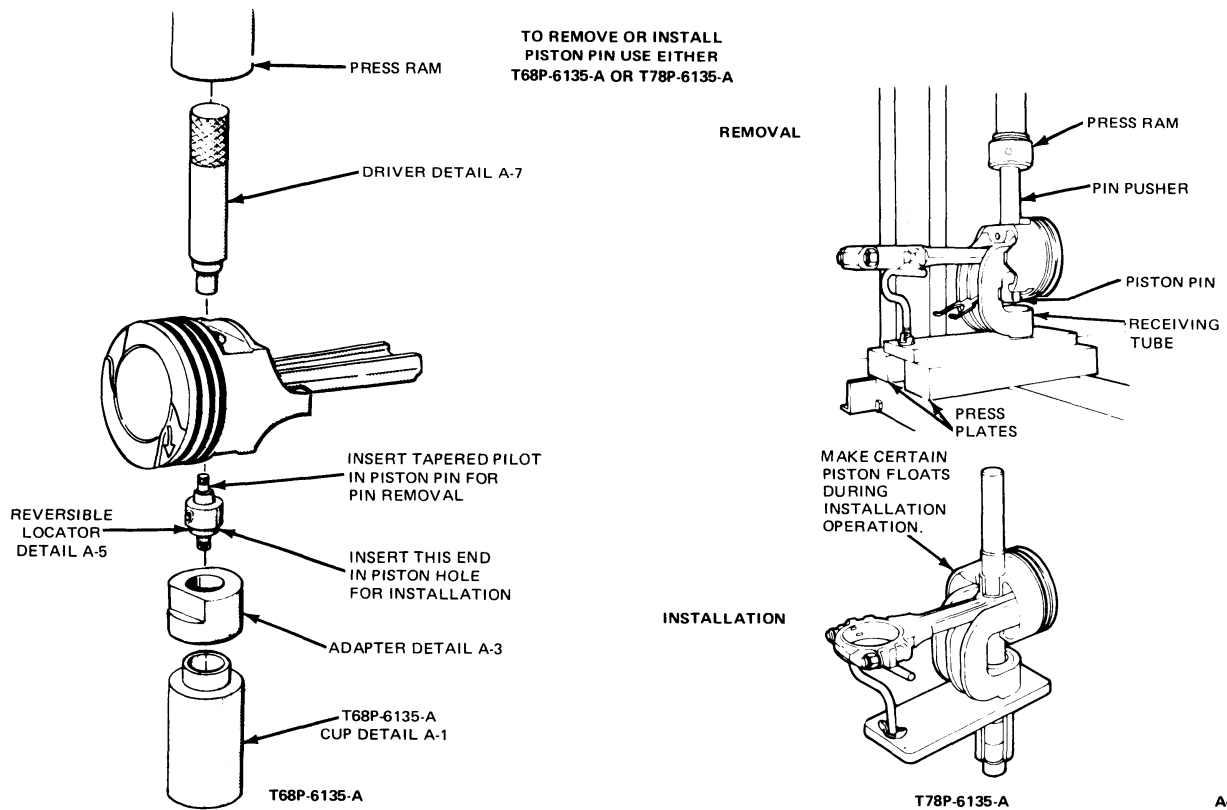


FIG. 40 Removing or Installing Piston Pin

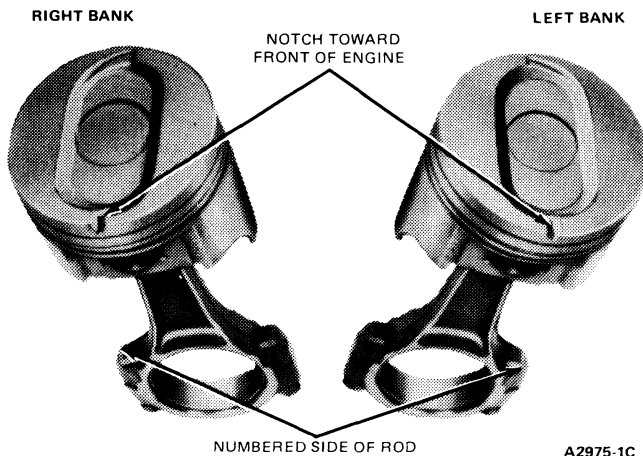


FIG. 41 Correct Piston and Rod Positions

3. Transfer all serviceable parts removed from the old cylinder assembly, following the procedures given in Removal and Installation of this Part.
4. Check all assembly clearances following Specifications listed at the end of this Part and correct as necessary.

CYLINDER BLOCK—6010

Before replacing a cylinder block, determine if it is repairable. If so, make the necessary repairs, following the procedures given in Part 21-01.

Disassembly

1. Mount the old engine in a work stand and completely disassemble it, following the procedures given in Removal and Installation of this Part.
2. Remember to ridge-ream the cylinder bores before removing piston assemblies.
3. Remove the cylinder head locating dowels and the block drain plugs.

Assembly

1. Clean the gasket and seal surfaces of all serviceable parts and assemblies.
2. Position the new cylinder block in a work stand and install the cylinder head locating dowels and the block drain plugs.
3. Transfer all serviceable parts removed from the old cylinder block, following the procedures given in Removal and Installation of this Part.
4. Check all assembly clearances following Specifications at the end of this Part and correct as necessary.

SPECIFICATIONS

GENERAL SPECIFICATIONS

Engine	Bore and Stroke	Firing Order	Oil Pressure Hot @ 2000 RPM kPa (PSI)	Engine Type and Number of Cylinders	Belt Tension (lbs) ①
7.5L (460 CID) V-8	4.36 x 3.85	15426378	276-448 (40-65)	O.H.V. V-8	—

①

Belt Size	Newly Installed ②		Used Less Than 10 Min.		Used Over 10 Min.	
	N•m	(lbs)	N•m	(lbs)	N•m	(lbs)
All except 1/4"	534-711	120-160	400-711	90-160 ③	334-533	75-120 ④
1/4" Only	223-355	50-80	178-355	40-80 ⑤	178-266	40-60 ⑥

② Tension measured immediately after belt is installed and before it is stretched or seats in pulley grooves (all belts).

③ If less than 400 N•m (90 lbs), readjust to 400-534 N•m (90-120 lbs).

④ If less than 178 N•m (40 lbs), readjust to 178-266 N•m (40-60 lbs).

⑤ If less than 334 N•m (75 lbs), readjust to 400-534 N•m (90-120 lbs).

CYLINDER HEAD

Engine	Combustion Chamber Volume C.C. ①	Valve Guide Bore Diameter		Valve Seat Width ①		Valve Seat Runout TIR Maximum	Valve Arrangement Front to Rear	Gasket Surface Flatness ②
		Intake	Exhaust	Intake	Exhaust			
7.5L (460 CID) V-8	94.7-97.7	.3433-.3443	.3433-.3443	.060-.080	.060-.080	.002	RT I-E-I-E-I-E-I-E LT E-I-E-I-E-I-E-I	.003 in any 6 in. .006 overall

① Valve seat angle — 45°

② Gasket surface finish — RMS 60-150.

③ Compression pressure (PSI) of the lowest cylinder must be at least 75% of the highest to be within specification.

VALVE ROCKER ARM SHAFT, PUSH RODS AND TAPPETS

Engine	Rocker Arm Lift Ratio to 1	Push Rod Runout TIR Maximum	Valve Tappet or Lifter			Collapsed Tappet Gap (Clearance)	
			Standard Diameter	Clearance to Bore ①	Hydraulic Lifter Leakdown Rate ②	Allowable	Desired
7.5L (460 CID) V-8	1.73	.015	.8740-.8745	.0007-.0027	10 to 50 seconds for 1/16 travel	.075-.175	.100-.150

① Service limit — .005.

② Time required for plunger to leakdown .0625 in. under load of 50 lbs. using leakdown fluid in tappet.

VALVE SPRINGS

Engine	Valve Spring Compression Pressure Lbs. @ Specified Height		Valve Spring Free Length (Approximate)		Valve Spring Assembled Height		Valve Spring Out of Square Maximum
	Intake ①	Exhaust	Intake	Exhaust	Intake	Exhaust	
7.5L (460 CID) V-8	76-84 @ 1.81 218-240 @ 1.33	76-84 @ 1.81 218-240 @ 1.33	2.06	2.06	1-51/64—1-53/64	1-51/64—1-53/64	5/64 (.078)

① Service limit — 10% loss of pressure.

VALVES

Engine	Valve Stem to Guide Clearance ①		Valve Head Diameter ①		Valve Face Runout TIR Maximum
	Intake	Exhaust	Intake	Exhaust	
7.5L (460 CID) V-8	.0010-.0027	.0010-.0027	2.075-2.090	1.646-1.661	.002

① Service clearance — .0055.

② Valve face angle — 44°.

VALVES (Continued)

Engine	Standard		Valve Stem Diameter .015 Oversize		.030 Oversize	
	Intake	Exhaust	Intake	Exhaust	Intake	Exhaust
7.5L (460 CID) V-8	.3416-.3423	.3416-.3423	.3566-.3573	.3566-.3573	.3716-.3723	.3716-.3723

CAMSHAFT

Engine	Lobe Lift ①		Camshaft End Play		Camshaft Journal to Bearing Clearance ②
	Intake	Exhaust	End Play	Service Limit	
7.5L (460 CID) V-8	.252	.278	.001-.006	.009	.001-.003

① Maximum allowable lift loss — .005.

② Service limit — .006.

CAMSHAFT DRIVE

Engine	Camshaft Journal Diameter — Standard ①					Camshaft Bearing Inside Diameter					Camshaft Front Bearing Location ②	Timing Chain Deflection Inches Maximum
	No. 1	No. 2	No. 3	No. 4	No. 5	No. 1	No. 2	No. 3	No. 4	No. 5		
7.5L (460 CID) V-8	2.1238-2.1248	2.1238-2.1248	2.1238-2.1248	2.1238-2.1248	2.1238-2.1248	2.1258-2.1268	2.1258-2.1268	2.1258-2.1268	2.1258-2.1268	2.1258-2.1268	.040-.060	.500

① Camshaft journal runout — .005 TIR maximum.

② Distance in inches that front edge of the bearing is installed below the front face of the cylinder block.

CYLINDER BLOCK

Engine	Cylinder Bore Diameter ①	Main Bearing Bore Diameter	Distributor Shaft Bearing Bore Diameter	Head Gasket Surface Flatness	Head Gasket Surface Finish	Tappet Bore Diameter
7.5L (460 CID) V-8	4.3600-4.3636	3.1922-3.1934	.5160-.5175	.003 in any 6 in. .006 overall	RMS 90-150	.8752-.8767

① Maximum out-of-round — .0015, Service limit — .005, Maximum taper service limit — .010, Cylinder bore surface finish RMS 18-38, Bore taper service limit — .010

CRANKSHAFT AND FLYWHEEL

Engine	Main Bearing Journal Diameter ①	Main Bearing Journal Runout TIR Maximum ②	Main Bearing Thrust Face Runout TIR Maximum	Main Bearing Journal Taper Maximum Per Inch	Thrust Bearing Journal Length	Main and Rod Bearing Journal Finish RMS Maximum	Main Bearing Thrust Face Finish RMS Maximum
7.5L (460 CID) V-8	2.9994-3.0002	.002	.001	.0005	1.124-1.126	12	25 Front—23 Rear

① Maximum out-of-round — .0006.

② Service limit — .005.

CRANKSHAFT AND FLYWHEEL (Continued)

Engine	Connecting Rod Journal Diameter ①	Connecting Rod Journal Taper Per Inch Maximum	Crankshaft Free End Play ②
7.5L (460 CID) V-8	2.4992-2.5000	.0006	.004-.008

① Maximum out-of-round — .0006.

② Service limit — .012.

CRANKSHAFT BEARINGS

Engine	Connecting Rod Bearing to Crankshaft Clearance Selective Fit			Main Bearing to Crankshaft Clearance Selective Fit		
	Desired	Allowable	Bearing Wall Thickness Std. ①	Desired	Allowable	Bearing Wall Thickness Std. ①
7.5L (460 CID) V-8	.0008-.0015	.0008-.0025	.0622-.0625	.0008-.0015	.0008-.0026	.0955-.0960

① For .002 undersize add .001 to standard wall thickness.

CONNECTING ROD

Engine	Piston Pin Bore or Bushing I.D.	Rod Bearing Bore I.D. ①	Rod Length Center to Center	Connecting Rod Alignment Maximum Total Difference		Rod to Crankshaft Assembled Side Clearance ③
				Twist ②	Bend ②	
7.5L (460 CID) V-8	1.0386-1.0393	2.6522-2.6530	6.6035-6.6065	.024	.012	.010-.020

① Connecting rod bearing bore maximum out-of-round — .0004.

② Pin bushing and crankshaft bore must be parallel and in same vertical plane within specified total difference when measured at the ends of an 8-inch long bar, 4 inches on each side of rod centerline.

③ Service limit — .023.

PISTON

Engine	Diameter ①			Piston to Bore Clearance Selective Fit	Piston Pin Bore Diameter	Ring Groove Width Compression		
	Coded Red	Coded Blue	.003 Oversize			Top	Bottom	Oil
7.5L (460 CID) V-8	4.3585-4.3591	4.3597-4.3603	4.3609-4.3615	.0022-.0030	1.0402-1.0405	.080-.0815	.0805-.081	.188-.189

① Measured at the piston pin bore centerline at 90° to the pin.

PISTON PIN

Engine	Length	Diameter		To Piston Pin Bore Clearance ①	To Connecting Rod Bushing Clearance
		Standard	.001 Oversize		
7.5L (460 CID) V-8	3.290-3.320	1.0398-1.0403	1.0410-1.0413	.0002-.0004	Interference Fit

① Selective Fit.

PISTON RINGS

Engine	Ring Width Compression		Side Clearance ①			Ring Gap		
			Compression		Oil	Compression		Oil
	Top	Bottom	Top	Bottom		Top	Bottom	
7.5L (460 CID) V-8	.077-.078	.0770-.0780	.0019-.0036	.002-.004	Snug	.010-.020	.010-.020	.010-.035

① Service limit — .002 maximum increase in clearance.

② Steel rail.

OIL PUMP AND OIL CAPACITY

Engine	Relief Valve Spring Pressure Lbs. @ Specified Length	Driveshaft to Housing Clearance	Relief Valve to Housing Clearance	Rotor Assembly End Clearance	Outer Race to Housing Clearance	Engine Oil Capacity Qts. — U.S. ①
7.5L (460 CID) V-8	20.6-22.6 @ 2.49	.0015-.0030	.0015-.0030	.004 Maximum	.001-.013	5

① Add 1 quart when replacing filter.

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FUEL PUMP — MECHANICAL

Engine	Static Pressure (PSI) ¹ E-100—E-350	Volume Flow — Minimum ¹ ²	Eccentric Total Lift — Inches
7.5L (460 CID) V-8	6.0-8.0	1 pint in 20 seconds	.602-.622

¹ On the engine with temperatures normalized and at normal curb idle speed, in neutral.

² The inside diameter of the smallest passage in the test flow circuit must not be less than .220.

TORQUE LIMITS — 7.5L (460 CID) V-8 ENGINE

NOTE: All values are in N·m (ft-lbs) unless otherwise noted. Oil threads with engine oil unless the threads require oil or water-resistant sealer. The standard torque limits listed below are applicable for all functions not listed in the special torque chart.

1/4-20	5/16-18	5/16-24	3/8-16	3/8-24	7/16-14	7/16-20	1/2-13	9/16-18
8-12 (6-9)	17-24 (12-18)	19-27 (14-20)	30-43 (22-32)	37-51 (27-38)	61-77 (45-57)	55-81 (40-60)	75-81 (55-60)	116-162 (85-120)

Pipe Threads

1/8-27	1/4-18	3/8-18	1/2-14
7-11 (5-8)	17-24 (12-18)	30-44 (22-23)	34-47 (25-35)

Item	Torque	
	N·m	(ft-lbs)
Camshaft Sprocket — Gear to Camshaft	55-61	(40-45)
Camshaft Thrust Plate to Cylinder Block	13-16	(9-12)
Connecting Rod Nut	55-61	(40-45)
Cylinder Front Cover — 5/16"	17-24	(12-18)
— 7/16"	62-74	(45-55)
Cylinder Head Bolts	①	
Damper to Crankshaft	95-122	(70-90)
EGR Valve to Carburetor Spacer or Intake Manifold	17-24	(12-18)
Carburetor Mounting Stud	7-13	(5-10)
Fuel Pump to Cylinder Block or Front Cover	26-36	(19-27)
Flywheel to Crankshaft	103-115	(75-85)
Main Bearing Cap Bolts	129-142	(95-105)
Manifold to Cylinder Head — Intake	30-43	(22-32)
Intake Manifold Vacuum Fittings	8-13	(6-10)
Manifold to Cylinder Head — Exhaust	38-44	(28-33)
Oil Filter Insert to Cylinder Block/Adaptor	62-74	(45-55)
Oil Filter Adapter to Cylinder Block	55-67	(40-60)
Oil Filter to Adaptor or Cylinder Block	1/2 turn after gasket contacts sealing surface — oiled gasket	
Oil Inlet Tube to Pump	17-24	(12-18)
Oil Inlet Tube to Main Bearing Cap	30-43	(22-32)
Oil Pan Drain Plug	21-33	(15-25)
Oil Pan to Cylinder Block	10-12	(7-9)
	13-14	(9-11)
Oil Pump to Cylinder Block	30-43	(22-32)
Pulley to Damper Bolt	48-67	(35-50)
Rocker Arm Stud/Bolt to Cylinder Head	25-33	(18-25)
Spark Plug to Cylinder Head	7-13	(5-10)
Valve Rocker Arm Cover	7-8	(5-6)
Water Outlet Housing	14-20	(10-15)
Water Pump to Cylinder Block or Front Cover	21-28	(15-21)
Alternator Bracket to Cylinder Block — Bolt	44-61	(30-45)
Alternator Pivot Bolt	62-77	(45-57)
Alternator Adjusting Arm to Cylinder Block Bolt	48-67	(35-50)
Alternator Adjusting Arm to Alternator Bolt	33-60	(24-40)
Thermactor Pump Bracket to Cylinder Block	41-61	(30-45)
Thermactor Pump Pivot Bolt	44-76	(30-45)
Thermactor Pump Adjusting Arm to Pump	30-43	(22-32)
Thermactor Pump Pulley to Pump Hub	17-24	(150-200 in-lbs)
Fuel Filter to Carburetor	3.28-4.18	(29-37 in-lbs)
Carburetor Attaching Nuts	17-20	(12-15)
Distributor Clamp Down	24-33	(17-25)

① Torque in steps: first to 108 (80), then to 149 (110), final to 177-189 (130-140).

CA4946-2A

Description	Ford Tool No.	Former No.	APPLICATION IN ENGINE SIZE			
			4.9L (300 CID) I-6	5.0L (302 CID) V-8 5.8L (351 CID) W-V-8	7.5L (460 CID) V-8	5.8L (351 CID) M-V-8 6.6L (400 CID) V-8
Engine Lifting Bracket — Use with T53L-300-A	T58P-6000-A	6000-BD			X	
Engine Lifting Hook	T60K-6000-A		X			
Engine Lifting Cradle	T65E-6000-B		X			
Engine Support Bar	T65E-6000-J		X			
Adapter Mount — To fit K.R. Wilson 1009 or Manzel 6001-TES	T64L-6001-B or T64L-6001-C	T52T-6005-CJD T52T-6005-KJD TOOL-6001-FBA	X	X	X	
Cylinder Front Cover Pilot	T61K-6019-A T61P-6019-B	4222-M, 6059-D 6059-F	X X	 X	 X	
Valve Guide Reamer Kit	T58P-6085-B T60K-6085-B	6085-H 6085-AE	 X		 X	
Piston Pin Remover and Replacer Press	T65L-6135-C	T60K-6135-B	X		X	
Piston Pin Remover	T52P-6135-DAD				X	
Camshaft Bearing Remover or Replacer	T56-6250-A					
Camshaft Bearing Remover and Replacer Adapters	T65L-6250-A	T52L-6261-CEE	X	X	X	X
Cylinder Head Core Plug, Cylinder Block Core Plug and Camshaft Bearing Bore Plug Replacer	T52L-6266-BGD	6266-B	X			
Crankshaft Sprocket and Crankshaft Damper Replacer	T52L-6306-AEE	3355-D 6306-AC		X		X
Crankshaft Damper Replacer	T64T-6306-A		X	X	X	
Crankshaft Damper Replacer — Use w/T64T-6306-A	T65L-6306-A		X			
Crankshaft Gear Installer	T52L-6306-AEE			X		X
Crankshaft Damper Remover Adapter Screw Use with T58P-6316-B	T64T-6316-A		X			
Crankshaft Damper Remover	T58P-6316-B		X		X	
Upper Main Bearing Insert Remover and Replacer	TOOL-6331	6331	X	X		X
Upper Main Bearing Insert Remover and Replacer	TOOL-6331-E	6331-E			X	
Hydraulic Tappet Clip Replacer	TOOL-6500-C	6500-C	X		X	
Impact Hammer	T50T-100-A		X	X	X	
Impact Slide Hammer (Replaces OTC-927)	T59L-100-B		X	X	X	X
Puller Attachment — Use with T50T-100-A or T59L-100-B	T58L-101-A	OTC-927	X	X	X	X
Handle Adapter	T53L-200-A		X	X	X	
Engine Lifting Sling	T53L-300-A	6000-BA	X	X	X	X
Gear Puller Ⓢ	TOOL-OTC-943		X			
Differential Backlash and Runout Gauge, with Universal Bracket Dial Indicator and Bracket — Includes Indicator TOOL-6565	TOOL-4201-C	4201-C	X	X	X	

Ⓢ Used on 4.9L (300 CID) I-6 engines only

CA4937-2A

Description	Ford Tool No.	Former No.	APPLICATION IN ENGINE SIZE			
			4.9L (300 CID) I-6	5.0L (302 CID) V-8 5.8L (351 CID) W-V-8	7.5L (460 CID) V-8	5.8L (351 CID) M-V-8 6.8L (400 CID) V-8
Hydraulic Tappet Leakdown Tester	T00L-6500-E	6500-E	X	X	X	
Hydraulic Tappet Plunger Remover and Replacer	T00L-6500-F	6500-F	X	X	X	
Hydraulic Lifter Remover	T52T-6500-DJD	6500-D			X	
Valve Stem Clearance Checking Tool	T65T-6505-H	6505-E		X		
Valve Stem Clearance Checking Tool	T00L-6505-G	6505-G	X			
Valve Spring and Rocker Arm Compressor	T00L-6513-J	6513-J			X	
Valve and Clutch Spring Tester	T00L-6513-DD	6513-DD	X	X	X	
Air Adapter and Hose-Valve Holdup	T00L-6513-ABA	6513-AB	X	X	X	
Rocker Arm Stud Kit	T62F-6A527-B	6527-A, B	X	X		
Cam Lift and Push Rod Stroke Dial Indicator — 1 inch range (Part of T00L-4201-C)	T00L-6565	6565	X	X	X	
Valve Spring Compressor	T62F-6565-A	6513-HH	X	X		
Cup Shaped Adapter to T00L-6565	T00L-6565-AB	6565-AB	X	X	X	
Cylinder Front Cover Oil Seal Installer	T68P-6700-A				X	
Cylinder Block Front Cover Oil Seal Replacer	T58P-6700-B	6700-B	X	X		
Adapter — Use with T53L-200-A	T58P-6700-A				X	
Crankshaft Rear Oil Seal Forming Tool	T58P-6701-A	6701-C			X	
Crankshaft Rear Oil Seal Forming Tool	T60K-6701-A	6701-E				
Crankshaft Rear Oil Seal Forming Tool	T65L-6701-A		X			
Clutch Pilot Bearing Replacer	T65L-7600-A		X			
Clutch Pilot Bearing Replacer	T00L-7600-H	7600-H		X		
Rocker Arm Stud Installer	T65P-6A527-A		X			
Rocker Arm Stud Installer	T69P-6049-D		X			
Crankshaft Gear Remover	T52L-6316-FEE or T52L-6316-EE		X			
Valve Compressor	T00L-6513-AC		X			
Piston Pin Remover	T68P-6135-A		X	X		X
Engine Lifting Bracket	T62F-6085-A			X		X
Spark Plug Wire Remover	T68P-6666-A			X	X	X
Hydraulic Valve Lifter Remover	T70L-6500-A			X		
Cylinder Head Holding Fixture	T62F-6085-A			X		X
Crankshaft Vibration Damper Remover	T58P-6316-A			X		
Crankshaft Vibration Damper Remover	T62F-6316-B			X		
Clutch Disc Locating Tool	T00L-6392-N			X		
Valve Compressor	T71P-6513-A			X	X	X
Valve Spring Compressor	T70P-6049-A				X	X
Hydraulic Valve Lifter Remover	T70P-14151			X		X
Front Cover Seal Remover	T70P-6B070-B					X
Front Cover Seal Installer	T70P-6B070-A					X
Camshaft Rear Bearing Bore Plug Installer	T70P-6011-A					X
Valve Stem Burr Remover	T70P-6505-A					X
Engine Lifting Sling	T75T-6000-A				X	

MANUAL TRANSMISSION SHIFT SCHEDULE

ENGINE TIMING SPECIFICATION

TIMING RPM SPECIFICATION

CHOKE SETTING SPECIFICATION

FAST IDLE RPM SPECIFICATION

CURB IDLE RPM SPECIFICATION

SPECIFICATION THROTTLE SOLENOID POSITIONER OFF RPM

ENGINE TYPE

TRANSMISSION GEAR POSITION DURING ADJUSTMENT

TRANSMISSION TYPE

SPARK PLUG TYPE AND GAP SPECIFICATION

CATALYST OR NON-CATALYST

Ford

FORD MOTOR COMPANY

VEHICLE EMISSION CONTROL INFORMATION

ENGINE FAMILY

ENGINE DISPLACEMENT

TRANS

SPARK PLUG GAP

CATALYST

EVAPORATIVE FAMILY IS

VACUUM HOSE ROUTING

SHIFT SCHED	TRANSMISSION GEAR	
	NEUTRAL	DRIVE
IGNITION TIMING		
MAX TIMING RPM		
CHOKE SETTING		
FAST IDLE RPM	HIGH CAM	
	KICK DOWN	
CURB IDLE RPM	A/C	
	NON A/C	
TSP OFF RPM	A/C	
	NON A/C	

SET PARKING BRAKE AND BLOCK WHEELS. DISCONNECT AUTOMATIC BRAKE RELEASE AND SENSOR CONNECTOR FROM DUAL MODE IGNITION MODULE IF SO EQUIPPED. MAKE ALL ADJUSTMENTS WITH ENGINE AT NORMAL OPERATING TEMPERATURE, A/C AND HEADLIGHTS OFF AND AIR CLEANER IN POSITION WHEN CHECKING ALL ENGINE SPEEDS. DISCONNECT AND PLUG (D/P) THERMACTOR AIR

ADJUSTMENT PROCEDURE NOTES

ADJUST IGNITION TIMING AND TIMING RPM TO SPEC. WITH VACUUM HOSE(S) DISCONNECTED AND PLUGGED AT THE DISTRIBUTOR. IF EQUIPPED WITH A THROTTLE SOLENOID POSITIONER DASHPOT, DISCONNECT SOLENOID WIRE AND COLLAPSE THE DASHPOT. SET RPM USING CARBURETOR SET SCREW.

FAST IDLE: ADJUST RPM TO SPEC. WITH TRANS IN NEUTRAL (M/T) OR PARK (A/T). FAST IDLE CAM IN SPECIFIED POSITION. D/P EGR VALVE VACUUM HOSE AT A. D/P PURGE VALVE VACUUM HOSE AT B.

CURB IDLE: ADJUST RPM TO SPEC. WITH TRANS IN SPECIFIED MODE AND ALL VACUUM HOSES CONNECTED EXCEPT BYPASS VALVE THROTTLE SOLENOID POSITIONER ENERGIZED AND DASHPOT COLLAPSED IF SO EQUIPPED.

TSP OFF: ADJUST RPM TO SPEC. WITH THROTTLE SOLENOID POSITIONER WIRE DISCONNECTED AND THE DASHPOT COLLAPSED IF SO EQUIPPED.

IDLE MIXTURE IS PRESET AT FACTORY. NOT ADJUSTED DURING SCHEDULED MAINTENANCE.

COMPLIANCE DEMONSTRATED BELOW 4000 FT

THIS VEHICLE CONFORMS TO U.S.E.P.A. REGULATIONS APPLICABLE TO 1980 MODEL YEAR NEW MOTOR VEHICLES

A5090-2A

IGNITION SYSTEM

GROUP
23
(12000)

PART TITLE	PART NO.	PART TITLE	PART NO.
General Ignition Service	23-01		

General Ignition Service

PART
23-01

APPLIES TO ALL TRUCK MODELS

SUBJECT	PAGE	SUBJECT	PAGE
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Module	23-01-2	Spark Plug Wires — DURA	
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Centrifugal Advance	23-01-3	SPECIFICATIONS	23-01-14
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Vacuum Advance/Retard —			
Dual Diaphragm Assembly	23-01-3		

INTRODUCTION

This Part covers the basic ignition systems for all Ford trucks and outlines general repair operations related to them. Refer to Part 29-02 for diagnosis and testing procedures.

1980 trucks are equipped with the DURA SPARK II, solid state breakerless system.

DESCRIPTION AND OPERATION

DURA SPARK II SYSTEM

DURA SPARK II is a solid state ignition system incorporating high energy secondary components. The

distributor, coil and module are the same as the SSI system. The system incorporates an adapter on the distributor to accommodate the large cap and the larger rotor used with the high voltage. The cap has spark plug

type terminal towers. The secondary wires are increased to 8mm with silicone jacketing for improved dielectric and temperature capability. "Suppressor" Spark plugs are released which incorporate an improved internal carbon seal of increased resistance to reduce radio frequency noise transmitted by the engine.

The high voltage and the wide spark plug gap increases spark plug life and overall engine performance. The higher voltage is accomplished through the use of a 1.10 ohm ballast resistor integral with the primary wire harness which increases the energy input to the coil and thus the system energy level. The system is readily identified by the large blue distributor cap and blue secondary wires.

The distributor is shown in Fig. 1 and ignition module in Fig. 2.

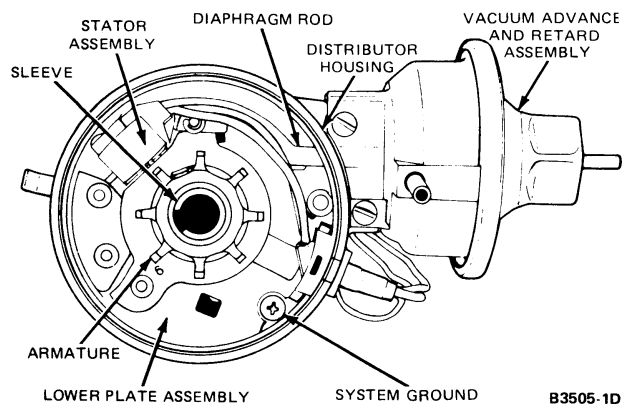


FIG. 1 Distributor—V-8 Shown

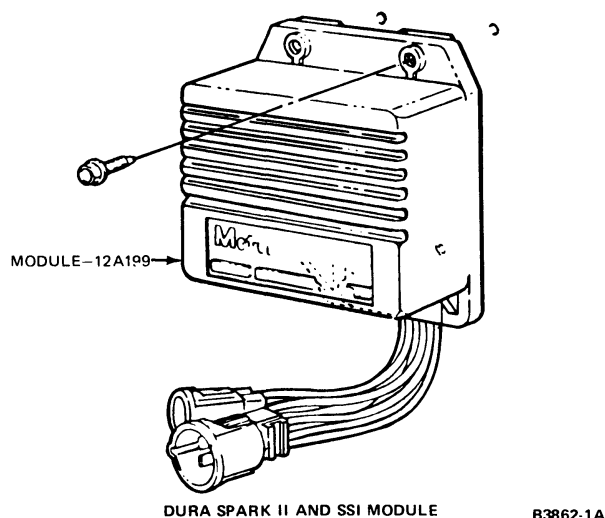


FIG. 2 Typical Ignition Modules

DUAL MODE TIMING IGNITION MODULE

On some applications, a special Dura-Spark II ignition module is used with altitude compensation (Fig. 2). This special module plus the barometric pressure switch allows the base engine timing to be modified to suit altitude conditions. All other elements and performance characteristics of this module are identical

in both modes of operation to the basic Dura-Spark II system. All Dura-Spark II Modules equipped with altitude feature have three connectors instead of the normal two.

A barometric switch provides an automatic retard signal to the module at different altitudes, giving appropriate advanced timing at higher altitude and retard mode for spark knock control at lower altitudes (Fig. 2).

DISTRIBUTOR

The armature turns with the distributor shaft, causing fluctuations in the magnetic field through the magnetic pick-up assembly. These fluctuations cause a varying voltage to be generated by the pick-up coil which causes the module to turn the ignition coil current off and on, which in turn provides the secondary voltage to the spark plugs.

The distributor (Fig. 3) is equipped with a 2-piece cap assembly(adapter and cap), and is used for Dura-Spark II systems.

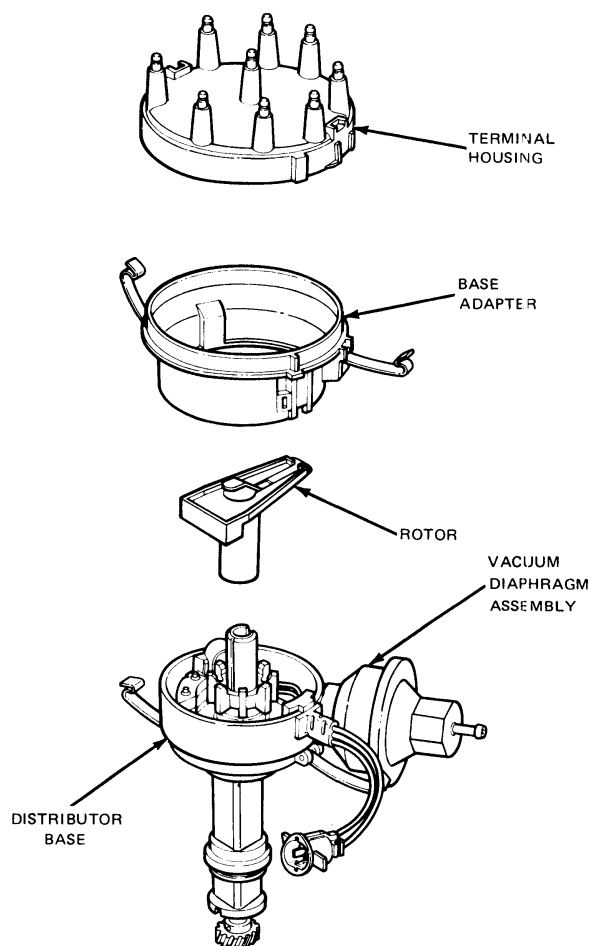


FIG. 3 Typical Breakerless Distributor—With Dura Spark II Rotor, Base Adapter and Cap

All distributors are equipped with both vacuum and centrifugal spark advance which operate the same regardless of the type of ignition system used. The vacuum advance governs ignition timing according to engine load, while the centrifugal advance governs ignition timing according to engine speed (rpm). A dual diaphragm vacuum advance is used on some engines to provide ignition timing retard during engine closed throttle operation. This occurs both at curb idle and during engine coast-down with closed throttle. Retarding the timing during these periods helps control engine exhaust emissions.

The distributor on six cylinder engines rotates in a clockwise direction. To advance timing, rotate the distributor counterclockwise. The distributor on V-8 engines rotates counterclockwise. To advance timing, rotate the distributor clockwise.

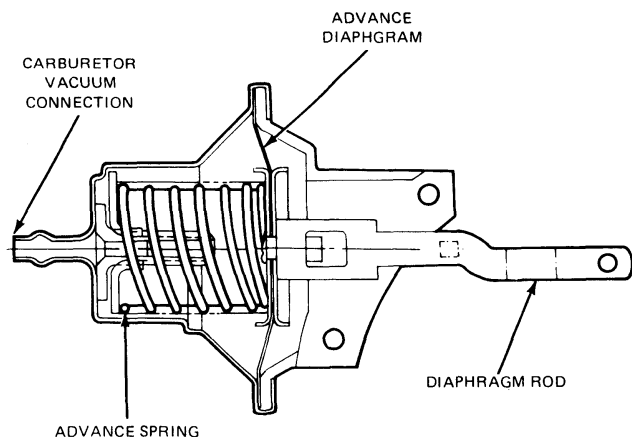
CENTRIFUGAL ADVANCE

The distributor advance units operate independently, with vacuum advance operating the stator assembly and centrifugal advance operating the position of the armature in relation to the distributor shaft. The centrifugal advance assembly, located below the lower plate assembly has spring loaded centrifugal weights that move inward or outward with changes in engine speed.

As engine speed increases, the weights move the sleeve and plate assembly ahead of the distributor shaft, thus advancing the position of the armature. The rate of advance is controlled by calibrated springs.

VACUUM ADVANCE—SINGLE DIAPHRAGM ASSEMBLY

The single diaphragm assembly has a spring loaded diaphragm connected to the movable stator assembly by the diaphragm rod. The diaphragm is moved against the spring pressure by vacuum (Fig. 4). When the vacuum increases, the diaphragm causes the movable stator assembly to pivot on the lower plate assembly.



B3798-1B

FIG. 4 Single Diaphragm Vacuum Advance Assembly

In the breakerless system, the stator assembly moves opposite to distributor rotation, advancing the spark timing.

VACUUM ADVANCE/RETARD—DUAL DIAPHRAGM ASSEMBLY

The dual diaphragm unit consists of two diaphragms that operate from two independent sources of vacuum (Fig. 5). The advance diaphragm normally operates from carburetor venturi vacuum to provide timing advance during normal off idle driving conditions. This diaphragm is connected to the movable stator assembly by the diaphragm rod.

The advance diaphragm is coupled to the movable stator assembly in much the same way as single diaphragm distributors. An increase in vacuum moves the diaphragm against the advance spring tension, causing the movable stator assembly to pivot opposite to distributor rotation advancing ignition timing. This occurs during normal road-load operation, but not during acceleration or idle.

The retard diaphragm operates from intake manifold vacuum and acts to retard ignition timing. This retard diaphragm is connected to the diaphragm rod by means of a sliding linkage. Since intake manifold vacuum is stronger than carburetor venturi vacuum during closed throttle operation, the retard diaphragm will retard the spark during these periods. In all other phases, the advance diaphragm operates from venturi vacuum and pulls the movable stator assembly against distributor rotation, advancing the spark timing.

When intake manifold vacuum is applied to the retard diaphragm it moves inward toward the distributor. This allows the advance diaphragm spring to move the advance diaphragm, causing the movable stator assembly to pivot in the same direction as distributor rotation. This retard of the ignition timing automatically occurs during engine idle or deceleration except when a distributor modulator is installed in the vacuum supply line.

CIRCUIT OPERATION

All systems consist of a primary (low voltage) and a secondary (high voltage) circuit (Fig. 6).

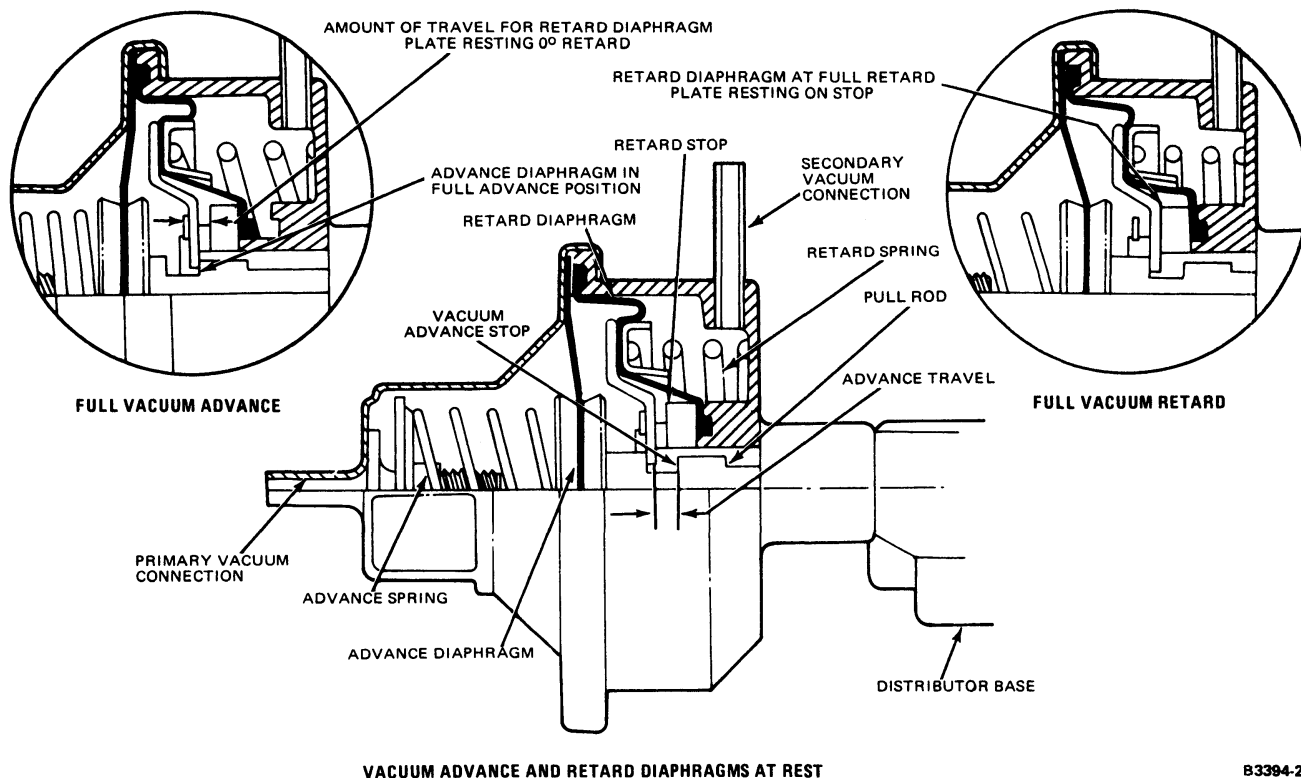
The primary circuit consists of the:

1. Battery.
2. Ignition Switch.
3. Primary Circuit Resistance. (Integral wire in SSI and DURA SPARK II.)
4. Primary windings of the ignition coil.
5. Magnetic pickup coil assembly.
6. Ignition Module.

The secondary circuit consists of the:

1. Secondary windings of the ignition coil.
2. Distributor rotor.
3. Distributor cap and adapter (Dura—Spark II).
4. Secondary (spark plug) wires.
5. Spark plugs.

With the ignition switch on, the primary circuit is energized and a magnetic field is built up by the current through the primary windings of the ignition coil. When the armature "spokes" align with the center of the magnetic pickup coil, the module turns off the coil primary current and high voltage is produced in the

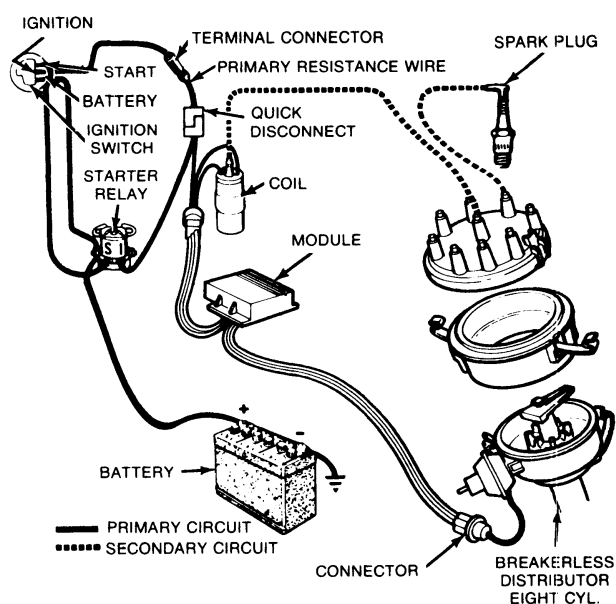


B3394-2C

FIG. 5 Dual Diaphragm Vacuum Advance Mechanism

secondary circuit by the collapsing magnetic field. High voltage is produced each time the field is thus built up and collapsed. A timing circuit in the module will turn the current on again after the magnetic field has collapsed. When the current is on, it flows from the battery through the ignition switch, the primary windings of the ignition coil and through the module to ground.

The high voltage flows through the coil secondary lead to the distributor cap where the rotor distributes it to one of the spark plug terminals in the cap. It then flows through the secondary wire to the spark plug.



B3787-1C

FIG. 6 Typical Ignition System Circuit

ADJUSTMENTS

No adjustments are made to the ignition system except initial timing and spark plug gap.

Ignition timing procedure is in Part 29-02, SSD-15.

TESTING

For System Testing and Diagnosis, refer to Part 29-02.

When servicing the DURA SPARK II System, whenever a secondary wire is removed for any reason from a spark plug, coil or cap, silicone grease must be applied to the boot before it is reconnected. Using a small clean tool, coat the entire interior surface of the

boot with Ford silicone grease D7AZ 19A331-A, Dow Corning No. 111, G.E. G-627, or equivalent.

When removing the DURA SPARK II distributor cap assembly, remove the cap (top part) first. Then remove the rotor before removing the base adapter (lower part).

REMOVAL AND INSTALLATION

DISTRIBUTOR—V-8 ENGINES

Removal

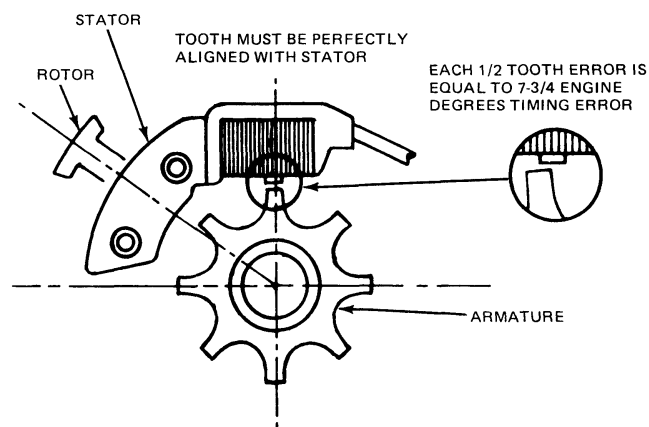
1. Remove the air cleaner. Disconnect the distributor primary wiring connector from the vehicle wiring harness (Fig. 6).
2. Disconnect the vacuum advance lines at the distributor. Remove the distributor cap and position it and the wires aside. Remove the rotor and the adapter. Re-install the rotor.
3. Scribe a mark on the distributor body and the cylinder block indicating the position of the rotor in the distributor and the distributor in the block. These marks will be used as guides when installing the distributor.
4. Remove the distributor hold down bolt and clamp. Lift the distributor out of the block. Do not rotate the engine while the distributor is out of the block, or it will be necessary to time the engine.

Installation

1. If the crankshaft was rotated while the distributor was removed from the engine, it will be necessary to time the engine as follows: Rotate the crankshaft until No. 1 piston is on TDC after the compression stroke. Align the correct initial timing mark on the timing pointer with the timing pointer on the crankshaft damper. Position the distributor in the block with one of the armature teeth as shown in Fig. 7 and the rotor at No. 1 firing position.

The cap is marked with an embossed No. "1" at the No. 1 terminal.

Make sure the oil pump intermediate shaft properly engages the distributor shaft. It may be necessary to crank the engine with the starter, after the distributor drive gear is partially engaged, in order to engage the oil pump intermediate shaft. If this is necessary, return the crankshaft to the initial timing alignment. Install, but do not tighten, the retaining clamp and bolt. Rotate the distributor to advance the timing to a point where the armature tooth is aligned properly. Tighten the clamp.



83509-1A

FIG. 7 Static Timing Position—Eight Cylinder

2. If the crankshaft has not been moved, position the distributor in the block with the rotor aligned with the mark previously scribed on the distributor body and the marks on the distributor body and cylinder block in alignment.
3. Remove the rotor from the distributor and install the base adapter. Re-install the rotor and then install the cap.
4. Connect the distributor wiring connector to the vehicle wiring harness.
5. Check the ignition timing with a timing light (Part 29-02) and adjust to specifications listed on engine decal. Connect the vacuum line(s), and check the advance with the timing light when the engine is accelerated.

NOTE: Higher Coil charging currents associated with the DURA SPARK II ignition system can false trigger some timing lights having capacitive coupled pickups. This false triggering will result in apparent multiple sparks and/or an erratic timing indication.

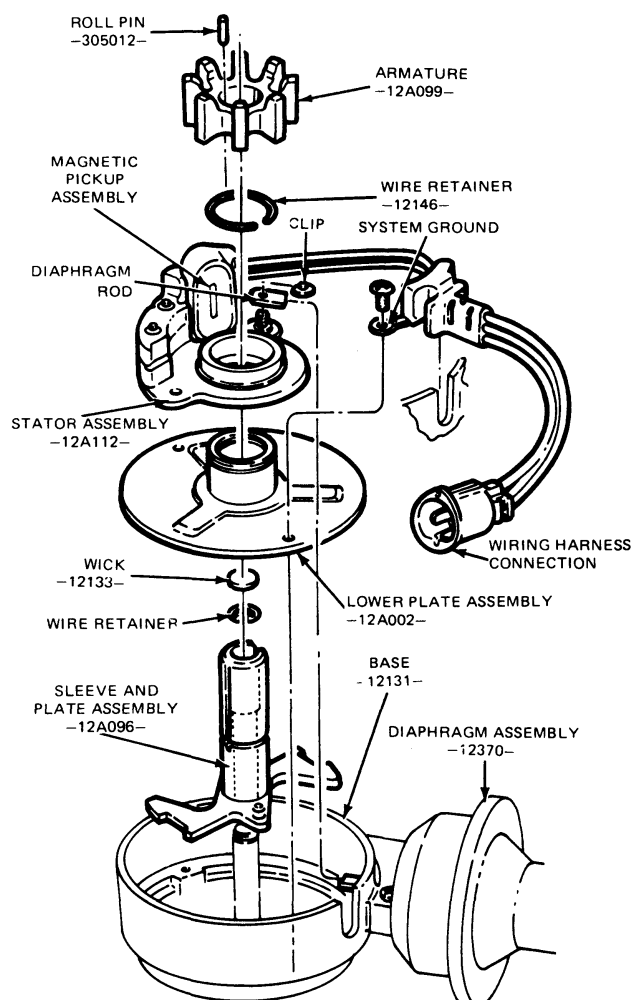
Use of timing lights with inductive type pick-ups such as Snap-on MT-212, Sun PLT-61 or SX-239 will eliminate this instrumentation problem.

Existing timing lights might also work satisfactorily if an insulating standoff, such as a split vacuum hose, is installed over the high tension lead before attaching the timing light pick-up.

STATOR ASSEMBLY—8-CYLINDER ENGINES

Removal

1. Remove the distributor cap, rotor and adapter and disconnect the distributor harness plug.
2. Using a small gear puller or two screwdrivers, lift or pry the armature from the sleeve and plate assembly. Remove the roll pin, (Fig. 8).
3. Remove the wire retainer from the annular groove on top of the bushing on the lower plate.



B3863-1A

FIG. 8 Typical Dura Spark Distributor-Eight Cylinder—Disassembled

4. Remove the ground screw retaining the ground strap and lower plate assembly to the base.
5. Grasp the lead wires outside the distributor bowl and pull up to remove the rubber grommet from the base.
6. Remove the "E" clip that secures the diaphragm rod to the stator assembly.
7. Lift the diaphragm rod off the post on the stator

assembly and rotate the stator assembly to position the post out from under the diaphragm rod.

8. Lift the stator assembly from the distributor.

Installation

1. Place the new stator assembly in position over the brushing on the lower base plate and slide the wire grommet in position through the slot in the side of the distributor base.
 2. Install the ground screw through the ground strap on the wiring harness and through the lower plate into the distributor base.
 3. Install the wire retainer securing the stator assembly to the fixed plate assembly.
 4. Position the diaphragm rod over the post on the stator assembly and install the "E" clip.
 5. Install the armature on the sleeve and plate assembly, making sure the roll pin is engaged in the matching slots.
- Note:** It is recommended that the original roll pin groove in the armature not be reused. Use the new groove 180° opposite the original groove. It is recommended to use a new roll pin.
6. Install the distributor adapter (if used), rotor and cap assembly.
 7. Connect the distributor wiring plug to the vehicle wiring harness.

VACUUM ADVANCE DIAPHRAGM ASSEMBLY—8-CYLINDER ENGINES

Refer to Fig. 8 for proper relationship of internal parts.

Removal

1. Remove the cap, rotor and adapter (if used).
2. Disconnect the vacuum lines.
3. Remove the "E" clip that secures the vacuum advance rod to the movable advance plate.
4. Remove the (2) two diaphragm attaching screws and carefully remove the unit by tilting downward to disengage the rod from the post on the movable stator assembly.

Installation

1. Position the vacuum advance assembly on the distributor and hook the advance rod in position on the top plate post.
2. Install the spring clip that secures the advance rod to the movable stator assembly. Install the (2) two diaphragm attaching screws. Be sure to replace the identification tag under the diaphragm attaching screw.
3. Reinstall the adapter, rotor and cap.
4. When a new diaphragm is installed on a distributor, it must be calibrated. The approved procedure for calibrating a diaphragm is included in the box with the new diaphragm.

Note: Be sure the new diaphragm is the correct part number.

LOWER PLATE ASSEMBLY—8-CYLINDER ENGINES

Removal

1. Remove the distributor cap, rotor and adapter.
2. Remove the diaphragm assembly.
3. Remove the stator assembly as shown in this Part.
4. Remove the remaining attaching screw from the lower plate and lift it out of the distributor.

Do not remove the sleeve and plate assembly, the weights, or the weight spring.

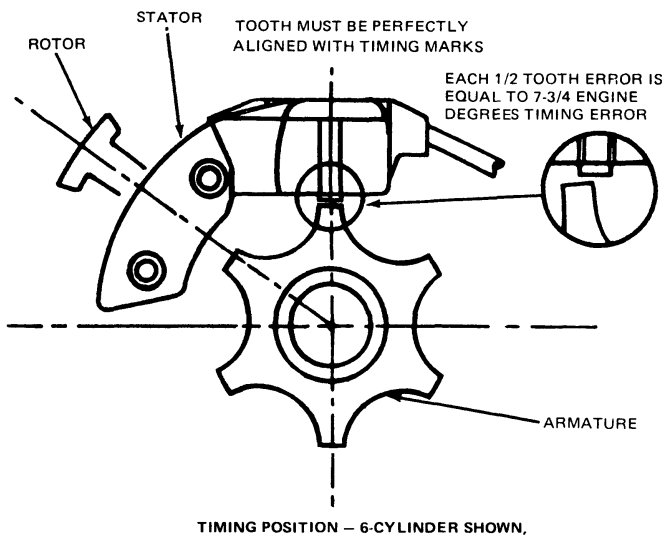
Installation

1. Position the lower plate assembly in the distributor and install the first attaching screw.
2. Install the stator assembly and associated wiring as shown in this part.
3. Install the diaphragm assembly.
4. Install the distributor adapter, rotor and cap.

DISTRIBUTOR—6-CYLINDER ENGINE

Removal

1. On 6-cylinder engines, remove one thermactor pump mounting bolt, and the drive belt; then, swing the pump to one side to allow access to the distributor. It may also be necessary to disconnect the Thermactor air filter and lines.
2. Disconnect the vacuum advance lines at the distributor. Remove the distributor cap and position it and the wires aside. Remove the rotor and the adapter. Re-install the rotor.
3. Scribe a mark on the distributor body and the cylinder block indicating the position of the rotor in the distributor and the distributor in the block. These marks will be used as guides when installing the distributor.
4. Remove the distributor hold down bolt and clamp. Lift the distributor out of the block. Do not rotate the engine while the distributor is out of the block, or it will be necessary to time the engine. On 4.9L engines, the hex shaft will be with drawn with the distributor.



TIMING POSITION — 6-CYLINDER SHOWN.

83739-1C

FIG. 9 Static Timing Position—6-Cylinder

Installation

1. Make sure the engine is still aligned with the proper timing marks. Align the distributor rotor with the marks on the distributor and the armature with the marks on the top of the magnetic pickup (Fig. 9). If the oil pump drive shaft was withdrawn with the distributor, coat one end with heavy grease, insert that end into the hex hole in the distributor shaft and position the distributor into the cylinder block. Make sure the oil pump drive shaft is fully seated in the pump, and that the distributor rotor and body are in the proper position.
2. Install the distributor hold-down bolt and bracket.
3. Install the vacuum hose(s) and connect the ignition wire to the wiring harness.
4. Install the rotor, adapter and distributor cap.
5. Install the thermactor belt and adjust belt tension to specification. Connect all Thermactor hoses and the filter.
6. Check engine timing as covered in Part 29-02.

STATOR ASSEMBLY—6-CYLINDER ENGINES

Removal

1. Remove the distributor cap, rotor and adapter and disconnect the distributor harness plug.
2. Using a small gear puller or two screwdrivers, lift or pry the armature from the sleeve and assembly plate. Remove the roll pin (Fig. 10).
3. Remove the two screws attaching the lower plate assembly, stator assemblies and ground strap to the distributor base. Grasp the coil lead wires near the rubber grommet and pull the grommet loose from the base.
4. Remove the "E" clip flat washer and wave washer that secure the stator assembly to the lower plate post. Separate the stator assembly from the lower plate assembly.

Installation

1. Secure the stator assembly in position on the lower plate assembly.

Note: The wave washer is positioned with the outer edges curled up.

2. Slide the wiring grommet into the slot at the edge of the lower plate and install the plate assembly on the distributor. Be sure the upper plate diaphragm pull rod bushing is inverted in the diaphragm pull rod hole. Install the two (2) lower plate attaching screws. The black cone-head screw attaches the lower plate assembly to the base. The yellow round-head screw attaches the ground strap and lower plate assembly to the base.
3. Install the armature on the sleeve and plate assembly, making sure the roll pin is engaged in the matching slots.

Note: It is recommended not to reuse the original roll pin groove in the armature. Use the new groove 180° opposite the original groove. It is recommended to use a new roll pin.

4. Install the distributor adapter, rotor and cap and

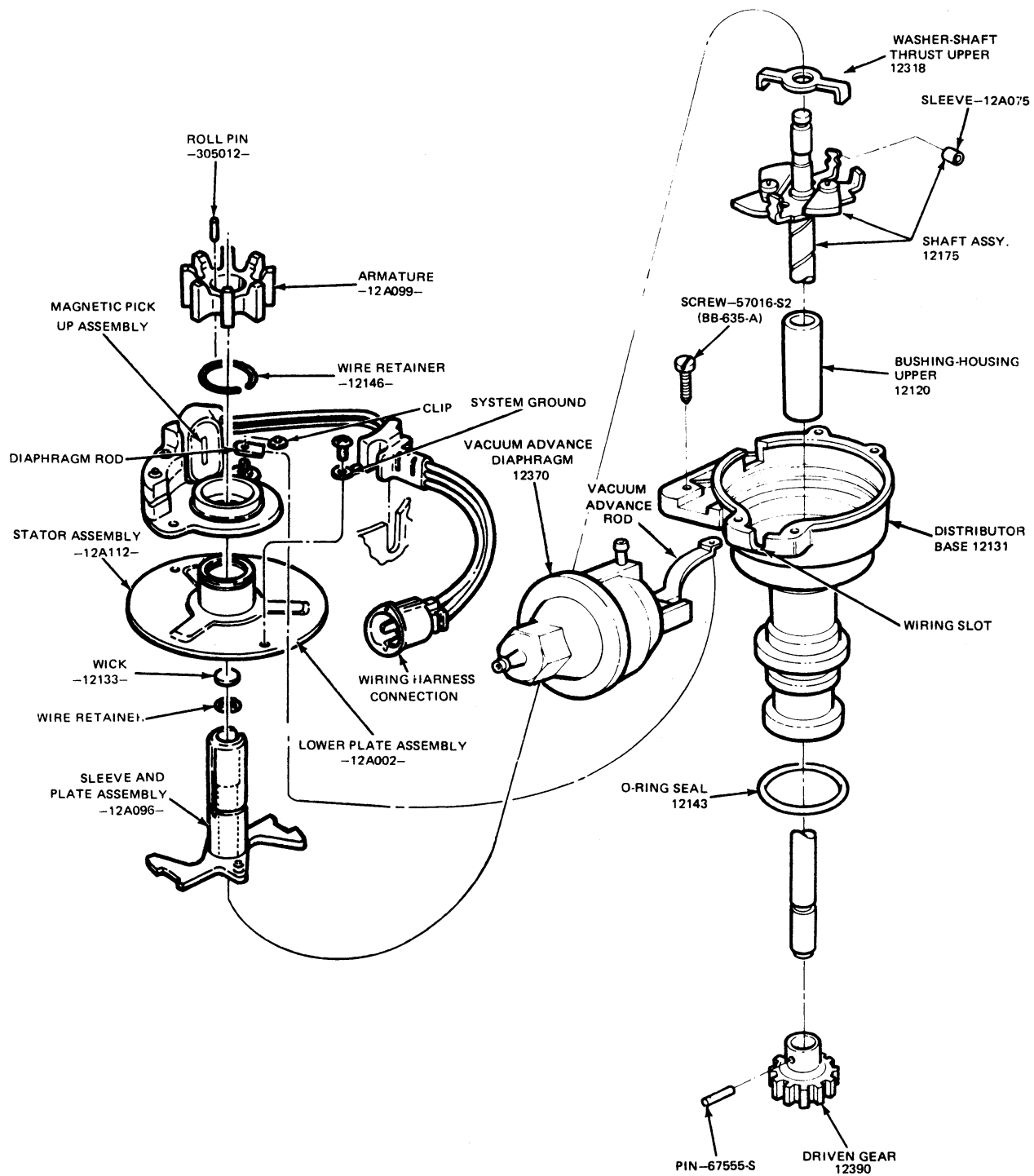


FIG. 10 Typical Breakerless Distributor—6-Cylinder—Disassembled

connect the distributor wiring plug to the vehicle harness.

VACUUM ADVANCE UNIT

Removal

1. Remove the distributor cap, rotor and adapter.
2. Disconnect the vacuum line(s).
3. Remove the diaphragm unit attaching screws and carefully remove the unit by tilting downward to disengage the rod from the stator assembly (Fig. 10). It may be necessary to lift the upper plate arm at the pull rod to assist in disengaging the pull rod.

Installation

1. Hook the diaphragm rod in position and position the diaphragm unit on the distributor.
2. Install the diaphragm unit attaching screws. Be sure to reinstall the identification tag under one of the attaching screws.
3. Connect the vacuum line.
4. Install the adapter, rotor and distributor cap.
5. When a new diaphragm is installed on a distributor, it must be calibrated. The approved procedure for calibrating a diaphragm is included in the box with the new diaphragm.

Note: Be sure the new diaphragm is the correct part number.

SPARK PLUG WIRES—DURA SPARK II (SECONDARY WIRES)

GENERAL

The secondary wires used with the DURA SPARK II system are 8mm to contain the higher output voltage. There are two types of wires used in the system and some engines will have both types. It is important to properly identify the type of wire used for each cylinder before replacements are made.

Both types are blue in color and have silicone jacketing. The insulation material underneath the jacketing may be EPDM or another silicone layer separated by glass braid. The cable incorporating EPDM is used where engine temperatures are cooler and are identified with the letters "SE." The silicone jacket silicone insulation type is used where high engine temperatures are present and is identified with the letters "SS."

NOTE: On any vehicle equipped with a catalytic converter, never allow the engine to run for more than 30 seconds with a spark plug wire disconnected. Use an oscilloscope for testing and diagnosis. Do not puncture wires or use adapters that can cause misfiring. Unburned fuel in the cylinders will ignite in the converter as it is exhausted and damage the converter.

Whenever a DURA SPARK II high tension wire is removed for any reason from a spark plug, coil or distributor cap, silicone grease must be applied to the boot before it is reconnected. Using a small clean tool, coat the entire interior surface of the boot with Ford silicone grease D7AZ 19A331-A, or G.E. G-627, Dow Corning 111, or equivalent.

The spark plug wire cables are marked with the cylinder number, model year and date of cable manufacture (quarter and year). Service replacement wires will not have cylinder numbers, or manufacturing date.

7 MM SECONDARY WIRES

These wires are the radio resistance-type which filter out the high frequency electrical impulses that are the source of ignition noise interference.

RESISTANCE CHECK

Check ignition wire resistance through the distributor cap. To check the secondary wire resistance, turn the ignition switch "off" and then remove the distributor cap. It is important that the ignition system be "off" to prevent inadvertent engine rotation due to firing of the ignition system.

Do not, under any circumstance, puncture an ignition cable when checking resistance. Do not use a commercial probing device, but measure resistance only from the ends of the wire or the wire terminals inside the distributor cap.

If the resistance of a wire exceeds 5,000 ohms per inch, it should be completely removed from the distributor cap and the resistance measured directly from the wire ends. If the resistance still exceeds 5,000 ohms per inch, the wire should be replaced.

Removal

When removing spark plug wires, use Tool T74P-6666-A or equivalent (Fig. 11). Grasp and twist the insulator back and forth on the spark plug to free the insulator. Do not pull on the wire directly as it may become separated from the connector inside the insulator.

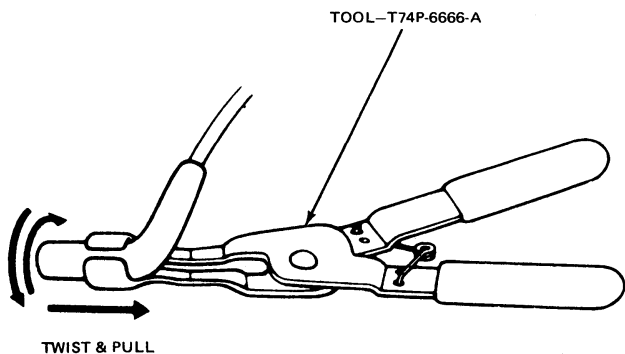
Installation

1. Install each wire in or on the proper terminal of the distributor cap. Be sure the terminal connector inside the insulator is fully seated. The No. 1 terminal is identified on the cap. On six-cylinder engines, install the wires in a clockwise direction (Fig. 12).

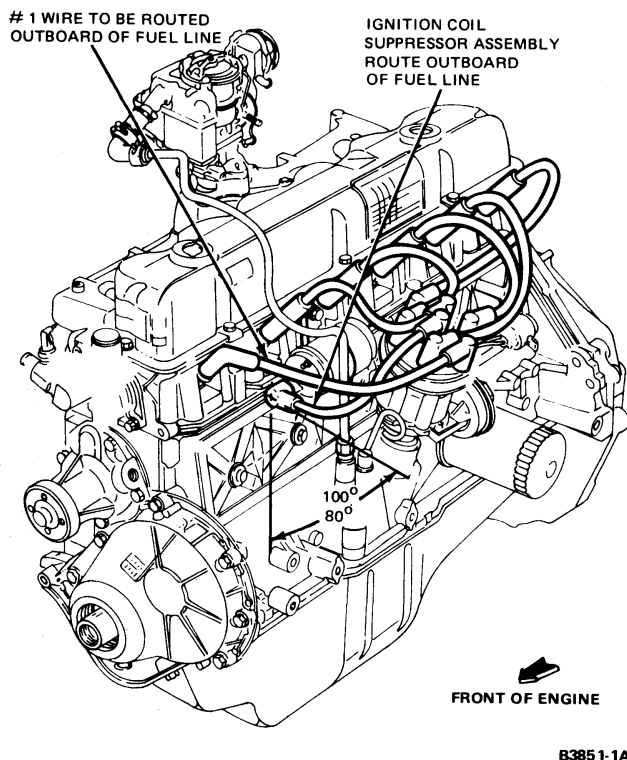
On 8 cylinder engines, cylinders are numbered from front to rear; right bank 1-2-3-4, left bank 5-6-7-8. On 8-cylinder engines install the wires in a counterclockwise direction in the firing order (1-5-4-2-6-3-7-8) starting at the No. 1 terminal for 5.0L (302 CID) V-8, 7.5L (460 CID) V-8. On 5.8L (351 CID) W V-8, 5.8L (351 CID) M V-8 and 6.6L (400 CID) V-8 the firing order is 1-3-7-2-6-5-4-8 (Fig. 13).

2. On 8-cylinder engines, remove the brackets from the old spark plug wire set and install them on the new set in the same relative position. Install the wires in the brackets on the valve rocker arm covers or studs (Fig. 13). Connect the wires to the proper spark plugs. Install the coil high tension lead.

The wires in the left bank bracket must be positioned in the bracket in a special order to avoid cylinder cross-fire. Be sure to position the wires in the bracket in the order from top bottom (front to rear for bracket) as shown in the Guide Fig. 14.



B3496-1A

FIG. 11 Removing Wires from Spark Plugs

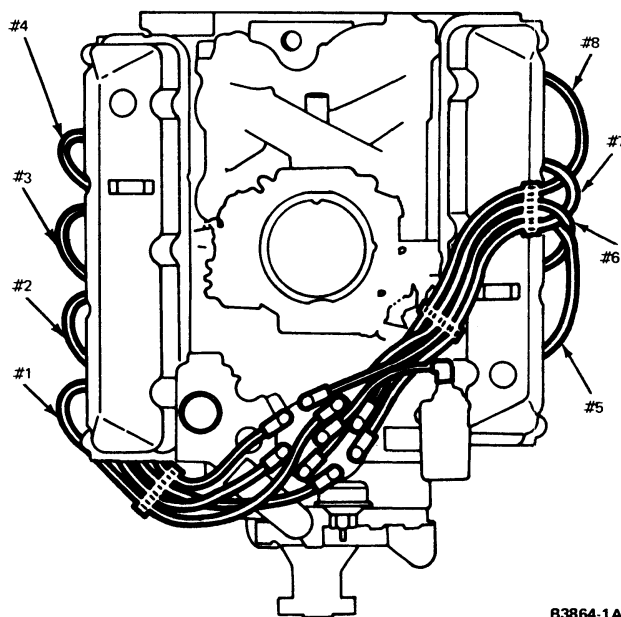
B3851-1A

FIG. 12 Typical Six-Cylinder Engine Secondary Ignition Wiring—Conventional Shown—Breakerless Similar**DISTRIBUTOR ROTOR AND CAP**

When installing a new distributor cap or rotor, coat the brass rotor electrode surfaces on all sides outboard of the plastic, including the outer edge, with D7AZ-19A331. A silicone grease (or equivalent Dow Corning No. 111 or General Electric G-627 compounds) to approximately 1/32" thickness. Do not reapply or attempt to remove any silicone coating from the distributor cap electrodes. As this compound ages, it has the appearance of being a contaminant of the cap and rotor electrodes. This condition is normal and causes no performance loss.

REPLACING SPARK PLUGS**Removal**

1. Remove the wire from each spark plug by grasp-



B3864-1A

FIG. 13 Typical Ignition Wiring V-8 Engines**TYPICAL IGNITION WIRING V-8 ENGINES**

5.8L (351 CID) W, M, V-8, 6.6L (400 CID) V-8	6-8-7-5
5.0L (302 CID) V-8, 7.5L (460 CID) V-8	8-6-5-7

CB3861-1A

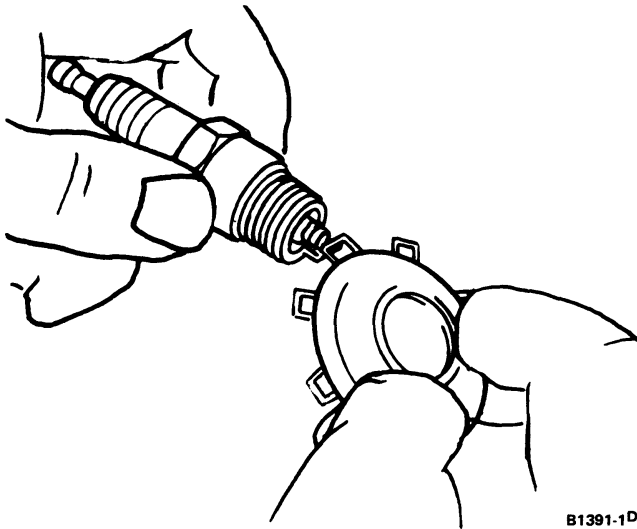
FIG. 14 Order of Wire Installation in Left Bank Bracket

ing the molded boot with Tool T74P-6666-A or equivalent (Fig. 11). Twist the boot until it loosens and then pull it off the spark plug. Do not pull on the wire, as the connection may become damaged.

2. Any wire damaged must be replaced. Each original spark plug wire is numbered for the cylinder to which it is designed. If wires are not numbered, each wire should be numbered as to the plug from which it was removed.
3. Clean the area around each spark plug port with compressed air.
4. Using the proper size spark plug socket remove the spark plugs.

Installation

1. Check the gap on each new spark plug and set to specification (as shown on engine emission decal) if necessary (Fig. 15).
2. Install each spark plug and tighten to specification.
3. Coat the inside of each spark plug boot with silicone grease D7AZ-19A331-A Dow Corning No. 111 G.E. G-627, or equivalent, using a small screwdriver blade. Connect each spark plug wire to the plug from which it was removed. Be sure each wire is fully depressed on each plug and molded boot is firmly in place.

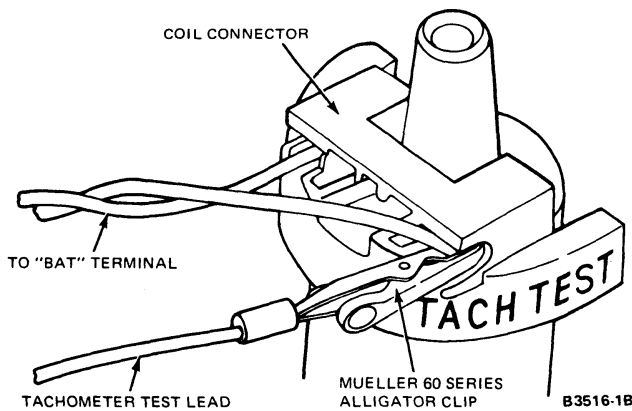


B1391-1D

**FIG. 15 Checking and Setting Spark Plug Cap
CONNECTING TO COIL CONNECTOR FOR
TACHOMETER TEST—ALL VEHICLES**

The ignition coil connector allows a tachometer test lead with an alligator-type clip to be connected to the "TACH TEST" terminal without removing the connector (Fig. 16).

When engine rpm must be checked, install the tachometer alligator clip into the "TACH TEST" cavity as shown. If the coil connector must be removed, grasp the connector and pull in the direction of the wires until it disconnects from the terminals.



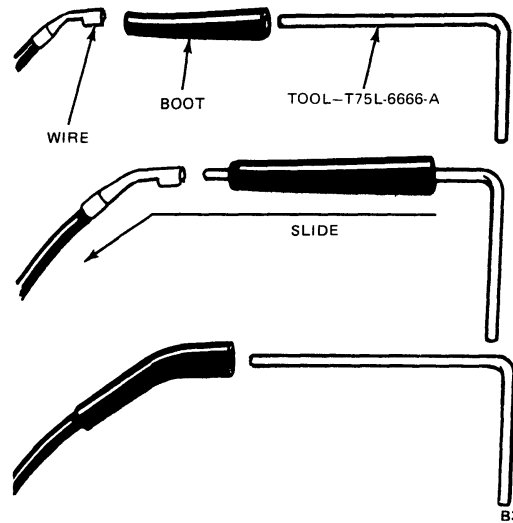
B3516-1B

**FIG. 16 Attaching Tachometer Lead to Coil
Connector**

SPARK PLUG BOOT REPLACEMENT—ALL ENGINES

When it is necessary to replace only the boot on a particular spark plug wire, proceed as follows:

1. Cut off the old boot. Apply silicone lubricant D7AZ-19A331-A, Dow Corning No. 1 G.E. G-627, or equivalent to that area of the old wire that will contact the new boot.
2. Position the new boot onto Tool T75L-6666-A or equivalent as shown in Fig. 17.



B3514-1B

FIG. 17 Installing Spark Plug Wire Boot on Wire

3. Position the tool onto the wire terminal and slide the boot onto the wire. Remove the tool from the end of the wire terminal.

CLEANING AND INSPECTION

SPARK PLUGS

Examine the firing ends of the spark plugs, noting the type of deposits and the degree of electrode erosion (Fig. 18). The electrode can be squared off by filing if it is not badly eroded (Fig. 19). Refer to Fig. 18 for the various types of spark plug fouling and their causes.

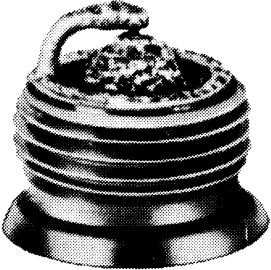
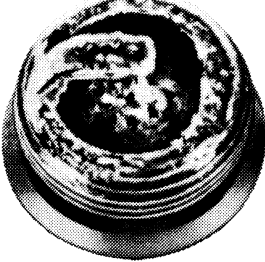
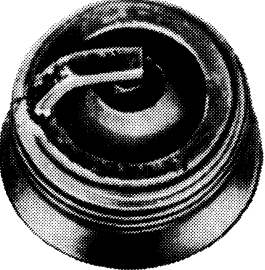
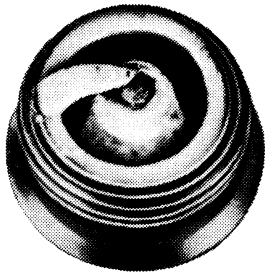
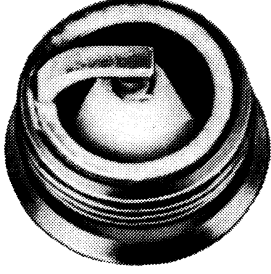
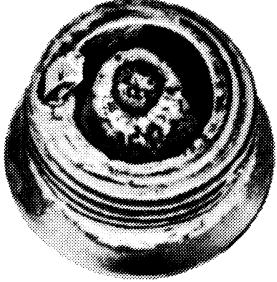
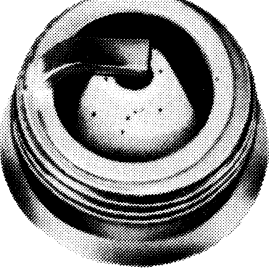
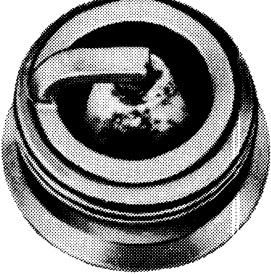
Clean the plugs on a sand blast cleaner, following the manufacturer's instructions. **Do not prolong the**

use of the abrasive blast as it will erode the insulator and electrodes.

Examine the plug carefully for cracked or broken insulators, badly pitted electrodes, and other signs of failure. Replace as required.

DISTRIBUTOR

To clean the distributor base put a cap on the distributor. Using a soft brush and a mild cleaning

GAP BRIDGED  IDENTIFIED BY DEPOSIT BUILD-UP CLOSING GAP BETWEEN ELECTRODES. CAUSED BY OIL OR CARBON FOULING. REPLACE PLUG, OR, IF DEPOSITS ARE NOT EXCESSIVE, THE PLUG CAN BE CLEANED.	OIL FOULED  IDENTIFIED BY WET BLACK DEPOSITS ON THE INSULATOR SHELL BORE ELECTRODES CAUSED BY EXCESSIVE OIL ENTERING COMBUSTION CHAMBER THROUGH WORN RINGS AND PISTONS, EXCESSIVE CLEARANCE BETWEEN VALVE GUIDES AND STEMS, OR WORN OR LOOSE BEARINGS. REPLACE THE PLUG. IF ENGINE IS NOT REPAIRED, USE A HOTTER PLUG.	CARBON FOULED  IDENTIFIED BY BLACK, DRY FLUFFY CARBON DEPOSITS ON INSULATOR TIPS, EXPOSED SHELL SURFACES AND ELECTRODES. CAUSED BY TOO COLD A PLUG, WEAK IGNITION, DIRTY AIR CLEANER, DEFECTIVE FUEL PUMP, TOO RICH A FUEL MIXTURE, IMPROPERLY OPERATING HEAT RISER OR EXCESSIVE IDLING. CAN BE CLEANED.
WORN  IDENTIFIED BY SEVERELY ERODED OR WORN ELECTRODES. CAUSED BY NORMAL WEAR. SHOULD BE REPLACED	NORMAL  IDENTIFIED BY LIGHT TAN OR GRAY DEPOSITS ON THE FIRING TIP.	LEAD FOULED  IDENTIFIED BY DARK GRAY, BLACK, YELLOW OR TAN DEPOSITS OR A FUSED GLAZED COATING ON THE INSULATOR TIP. CAUSED BY HIGHLY LEADED GASOLINE. REPLACE THE PLUG.
PRE-IGNITION  IDENTIFIED BY MELTED ELECTRODES AND POSSIBLY BLISTERED INSULATOR. METALLIC DEPOSITS ON INSULATOR INDICATE ENGINE DAMAGE. CAUSED BY WRONG TYPE OF FUEL, INCORRECT IGNITION TIMING OR ADVANCE, TOO HOT A PLUG, BURNT VALVES OR ENGINE OVERHEATING. REPLACE THE PLUG.	OVERHEATING  IDENTIFIED BY A WHITE OR LIGHT GRAY INSULATOR WITH SMALL BLACK OR GRAY BROWN SPOTS AND WITH BLuish-BURNT APPEARANCE OF ELECTRODES, CAUSED BY ENGINE OVERHEATING. WRONG TYPE OF FUEL, LOOSE SPARK PLUGS, TOO HOT A PLUG, LOW FUEL PUMP PRESSURE OR INCORRECT IGNITION TIMING. REPLACE THE PLUG.	FUSED SPOT DEPOSIT  IDENTIFIED BY MELTED OR SPOTTY DEPOSITS RESEMBLING BUBBLES OR BLISTERS. CAUSED BY SUDDEN ACCELERATION. CAN BE CLEANED IF NOT EXCESSIVE. OTHERWISE REPLACE PLUG.

B3235-28

FIG. 18 Spark Plug Inspection

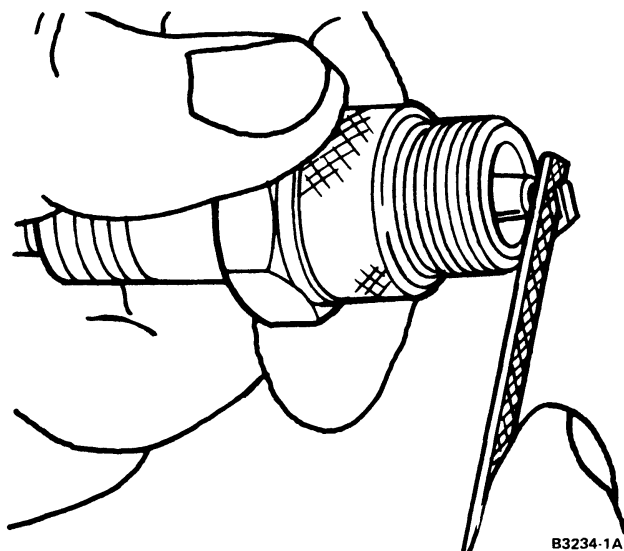


FIG. 19 Filing Spark Plug Electrode

solvent or mineral spirits, clean the outside, being careful not to get the cleaning solution on the wiring or inside the distributor. **Do not use a wire brush, file, or other abrasive object.** Dry the parts with compressed air.

Check the distributor base for cracks or other damage.

Check the diaphragm housing and rod for damage.

Inspect the wiring on the stator assembly. Replace stator assembly if wiring insulation is cracked.

Inspect the magnet and pickup coil. Make sure no filing or metal chips are on the magnet or pickup coil. Blow assembly clean with compressed air. Be sure that all "E" rings are in place and that the stator assembly moves on the lower plate assembly with vacuum applied to advance unit.

DISTRIBUTOR CAP

Wipe the distributor cap with a clean, damp cloth. Dry the cap with compressed air. Inspect the cap for cracks, burned contacts, broken carbon button, carbon tracks or dirt or corrosion in the sockets. Replace the cap if it is damaged.*

ROTOR

Wipe the rotor with a clean, damp cloth. Dry the rotor with compressed air. Inspect the rotor for breaks, cracks, carbon tracks or burns. Replace the rotor if it is corroded or damaged.*

***NOTE: When it is necessary to clean a distributor cap or rotor for inspection, or when a new cap or rotor is being installed, silicone grease must be applied as outlined under distributor Rotor and Cap Installation.**

SECONDARY WIRING

Without removing from the engine, inspect the secondary wires for visible damage such as cuts, pinches, cracks or torn boots. Do not remove wires from distributor cap. Replace wires that are damaged. If spark plug boot is damaged, replace it (refer to Spark Plug Boot Replacement—All Engines, in this Part).

COIL

Wipe the coil high-voltage tower with a damp cloth and air dry. Check for any cracks or other defects.

IGNITION PRIMARY RESISTANCE WIRE REPLACEMENT

1. Disconnect the battery negative (ground) cable.
2. Working in the engine compartment, carefully drill a one-half inch hole through the dash panel in the location shown in Fig. 20. Be careful not to contact the No. 14401 harness with the drill.

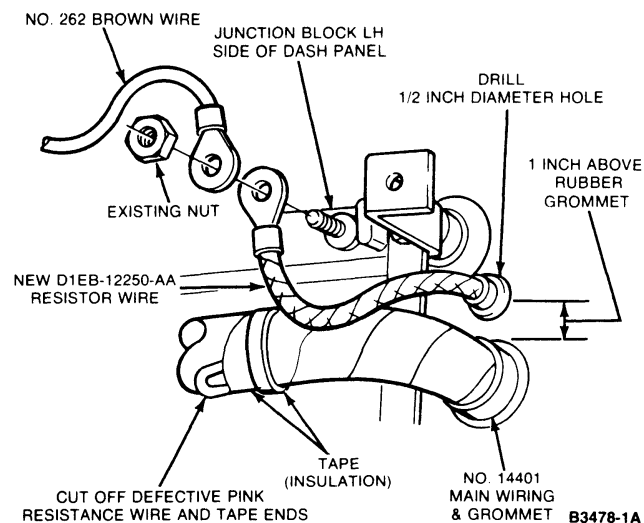


FIG. 20 Resistance Wire Hole Location

3. Line Haul Only. Working from inside the cab, locate the multiple (3 socket green) connector behind the lower instrument panel. Connect the bullet terminal end of the new D1HB-12250-AA resistor wire into one of the sockets (Fig. 21).

DISTRIBUTOR IDENTIFICATION

The distributor identification number is stamped on the identification tag attached to the distributor base by one of the vacuum advance unit attaching screws. The basic part number for distributors is 12127. To procure replacement parts, it is necessary to know the part number prefix and suffix code change (Fig. 22).

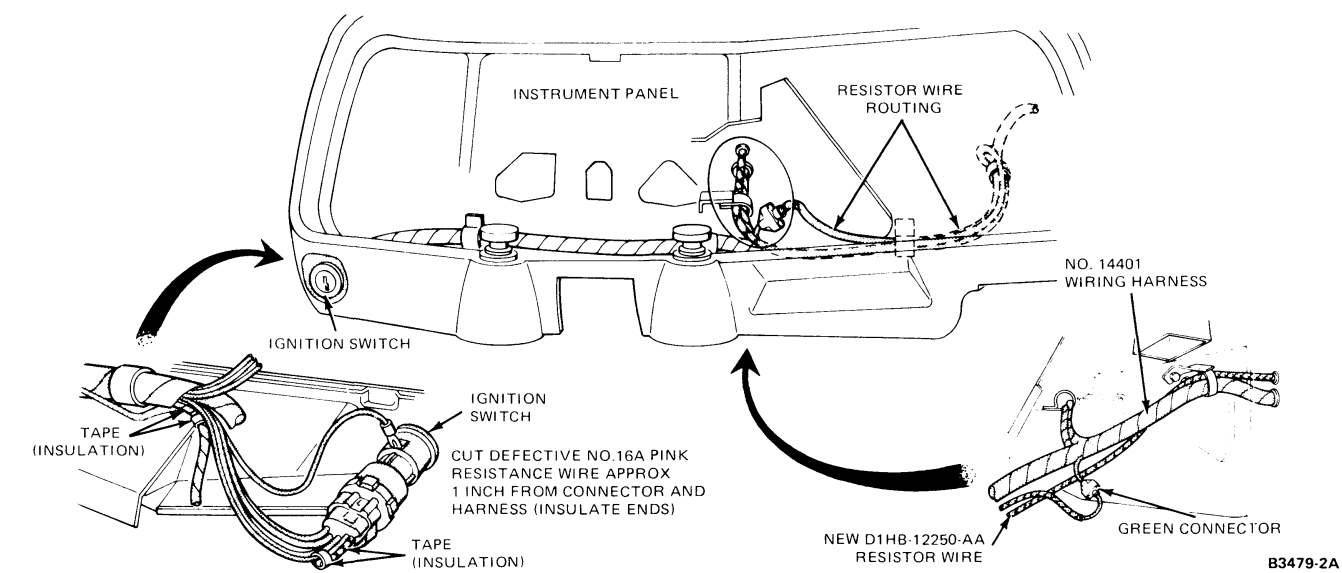


FIG. 21 Resistance Wire Connection Inside of Cab-Line Haul Vehicle

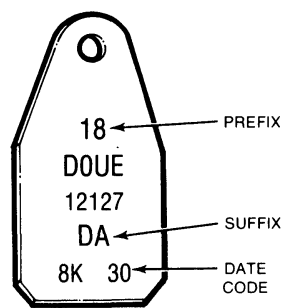


FIG. 22 Distributor Identification

SPECIFICATIONS

DISTRIBUTOR GENERAL INFORMATION ①

Engine	Rotor Air Gap Voltage Drop (Max.)	Distributor Shaft End Play	Gear Location
4.9L (300 CID) I-6	8KV	.003-.010	N.A.
5.0L (302 CID) V-8		.024-.035	4.031-4.038
5.8L (351 CID) W V-8			
5.8L (351 CID) M V-8			
6.6L (400 CID) V-8			
7.5L (460 CID) V-8			

Number	Description
T75L-6666-A	Spark Plug Boot Replacing Tool
ARE-27-55 or ARE-881	Ignition Oscilloscopes
T74P-6666-A	Spark Plug Wire Removing Tool
T64T-12450-A	Velocity Governor Wrench
①	Timing Light

① Various types available — must have inductive type pick-ups. CB1098-1G

① Refer to specification booklet for performance specifications.
② Measured with distributor removed.
③ Distance from bottom of mounting flange to bottom of gear including end play.
CB1118-1G

FUEL SYSTEM — GASOLINE ENGINES

**GROUP
24
(9000)**

PART TITLE	PAGE NO.	PART TITLE	PAGE NO.
Air Cleaner — Dry Type	24-41-1	General Fuel System Service —	
Air Cleaner Duct System	24-42-1	Gasoline Engines	24-01-1
Air Cleaner — Oil Bath Type	24-40-1	Model YFA 1-V Carburetor	24-06-1
Fuel Filters	24-51-1	Model 2150 2-V Carburetor	24-25-1
Fuel Pump — Mechanical	24-30-1	Model 4180 4-V Carburetor	24-80-1
Fuel Tanks and Lines and Evaporative Emission Control System	24-50-1	Throttle Linkage	24-60-1

General Fuel System Service — Gasoline Engines

**PART
24-01**

APPLIES TO ALL MODELS

SUBJECT	PAGE	SUBJECT	PAGE
ADJUSTMENTS	24-01-2	DESCRIPTION	24-01-1
CLEANING AND INSPECTION		TESTING	24-01-1
Carburetors	24-01-2		
Mechanical Fuel Pumps —			
Gasoline Engines	24-01-3		

DESCRIPTION

All engines incorporate a closed-type positive crankcase ventilation system and an exhaust emission system to control engine emissions within Government specifications.

To maintain the required exhaust emission levels, the carburetor must be kept in good operating condition and adjusted to specifications listed in the applicable Carburetor Part of this Volume, Group 29 of this Volume, the Pre-Delivery, Maintenance and Lubrication Manual, the Truck Performance Specification Book, or on the engine decal.

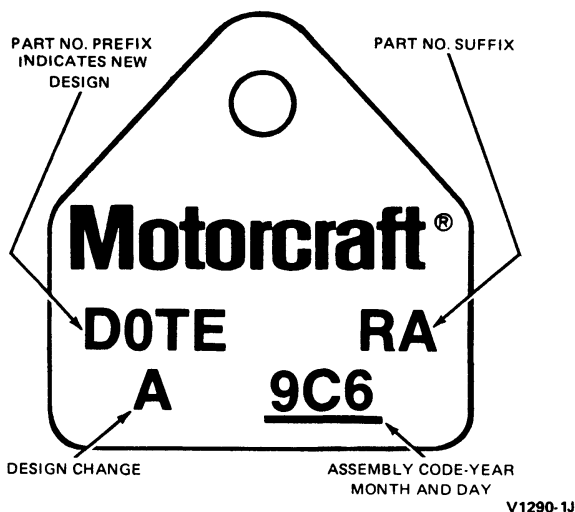
Additional engine performance checks are required to keep the exhaust emissions at the specified minimum pollutant level. Refer to the applicable owners manual for these performance checks and the recommended intervals.

This part covers general fuel system tests, adjustment and repair procedures. In addition, the cleaning and inspection procedures are covered.

For fuel system component removal, disassembly, assembly, installation and major repair procedures, refer to the pertinent part of this Group.

The carburetor identification tag is attached to the carburetor. The basic part number for all carburetors is 9510. To procure replacement parts, it is necessary to know the part number prefix and suffix and, in some instances, the design change code (Fig. 1).

Always refer to the Master Parts List for parts usage and interchangeability before replacing a carburetor or a component part of a carburetor.



On all engines requiring unleaded fuel, the "Unleaded Fuel Only" nomenclature must appear:

1. near the fuel filler opening.
2. on the instrument cluster.

FIG. 1 Typical Carburetor Identification Tag

TESTING

Refer to Part 29-02, of this manual and Part 50-29 in the Pre-Delivery, Maintenance and Lubrication Manual for carburetor testing procedures.

ADJUSTMENTS

Refer to Part 29-02, of this manual and Part 50-29 the Pre-Delivery, Maintenance and Lubrication Manual for carburetor adjusting procedures.

CLEANING AND INSPECTION

CARBURETORS

Dirt, gum, water or carbon contamination in the carburetor or the exterior moving parts of the carburetor are often responsible for unsatisfactory performance. For this reason, efficient carburetion depends upon careful cleaning and inspection.

The cleaning and inspection of only those parts not included in the carburetor overhaul repair kit are covered here. All gaskets and parts included in the repair kit should be installed when the carburetor is assembled and the old gaskets and parts should be discarded.

Wash all parts except the rubber or solid nitrophyl carburetor float (if so equipped), the accelerating pump diaphragm, the power valve or power valve diaphragm, the fuel enrichment valve (4-V carburetor), the secondary throttle diaphragm (4-V carburetor), the governor diaphragm—the choke pull down motor or diaphragm (2V carburetors), and the anti-stall dashpot diaphragm in clean commercial carburetor cleaning solvent. If a commercial solvent is not available, lacquer thinner or denatured alcohol may be used.

Rinse the parts in kerosene to remove all traces of the cleaning solvent, and then dry them with compressed air. Wipe all parts that can not be immersed in solvent with a clean, soft, dry cloth. Be sure all dirt, gum, carbon and other foreign matter are removed from all parts.

Check the metal float(s) for leaks by holding it under water that has been heated to just below the boiling point. Bubbles will appear if there is a leak. If a float leaks, replace it. Replace the float if the arm needle contact point is grooved. If the float(s) is serviceable, polish the needle contact surface of the arm with crocus cloth or steel wool. Replace the float shaft(s) if it is worn.

Force compressed air through all passages of the carburetor. **Do not use a wire brush to clean any parts or a drill or wire to clean out any openings or passages in the carburetor.** A drill or wire may enlarge the hole or passage, changing the calibration of the carburetor.

Check the choke shaft for grooves, wear, and excessive looseness or binding. Inspect the choke plate

for nicked edges and for ease of operation. Free the shaft and plate, if necessary.

Check the throttle shaft(s) in its bore for binding. Check the throttle plate(s) for burrs which prevent proper closure.

Check the action of the poppet valves in the choke plate and the poppet valves in the air horn (Holley 4-V carburetor). Free them, if necessary.

Inspect the main body, throttle body and metering block (Holley carburetors) air horn, nozzle bars and booster venturi assemblies (2-V and 4-V carburetors), power valve cover, accelerating pump cover, and the secondary diaphragm housing (Holley 4-V carburetor) for cracks.

Replace all screws and nuts that have stripped threads. Replace all distorted or broken springs.

Inspect all gasket mating surfaces for nicks and burrs. Repair or replace any parts that have a damaged gasket surface.

On the Holley 2-V or 4-V carburetors, inspect the main and accelerating pump discharge nozzles and idle restrictions. If any of the openings are blocked, open them with compressed air.

On the Motorcraft 2-V carburetor, inspect the idle tubes in each nozzle bar assembly. If they are plugged, bent, or broken, replace the booster venturi and nozzle bar assembly. If the carburetor is equipped with mechanical fuel bowl vent valve, check for proper operation. If necessary remove the umbrella washer and repair or replace valve components.

Inspect the rubber boot of the anti-stall dashpot, (if so equipped), for proper installation in the groove of the stem bushing. Check the stem movement for smooth operation. Do not lubricate the stem. Replace the assembly if it is damaged.

MECHANICAL FUEL PUMPS—GASOLINE ENGINES

Inspect the fuel pump for cracks or damage. Inspect the mounting flange for distortion. Lap the distorted flange, if necessary. Inspect the rocker arm spring, pin and the rocker arm for wear, cracks or damage. **If any fuel pump components are damaged, replace the fuel pump.**

Model YFA 1-V Carburetor

**PART
24-06**

APPLIES TO 4.9L (300 CID) I-6 ENGINES

SUBJECT	PAGE	SUBJECT	PAGE
ADJUSTMENTS		DESCRIPTION	
Automatic Thermostatic		Carburetor	24-06-1
Spring Housing	24-06-4	DISASSEMBLY AND ASSEMBLY	
Choke Plate Pulldown	24-06-4	Carburetor Assembly	24-06-9
Dechoke Adjustment	24-06-4	REMOVAL AND INSTALLATION	
EGR Wide Open Throttle		Air Horn to Main Body Gasket	24-06-6
(WOT) Dump Valve	24-06-6	Carburetor Assembly	24-06-7
Fast Idle Cam Index	24-06-2	Float or Needle Valve	24-06-7
Fast Idle Speed	24-06-2	Main Metering Jet, Low-Speed	
Float Drop Adjustment	24-06-5	Jet, Metering Rod and	
Float Level Adjustment	24-06-5	Accelerator Pump	24-06-7
Mechanical Fuel Bowl Vent	24-06-5	SPECIFICATIONS	24-06-11
Metering Rod Adjustment	24-06-5		
Vacuum Operated Throttle Kicker	24-06-4		

DESCRIPTION

CARBURETOR ASSEMBLY

The Carter Model YFA 1-V is used on all 4.9L (300 CID) 1-6 engines in F-100-F-350, E-100-E-350 and Bronco 49 states and California.

The Carburetor is made up of three main assemblies: the air horn, the main body and throttle body (Fig. 1). The YFA 1-V carburetor has a vacuum piston type automatic choke and an electric assist choke cap.

The air horn, which serves as the main body cover, contains the choke plate, an internal vent for the fuel bowl, automatic choke thermostatic control and electric assist choke. It also contains the fuel inlet fitting, inlet needle and seat and the float and lever assembly and the mechanical bowl vent valve assembly. Carburetors have a solepot unit attached to the airhorn by means of a bracket. The automatic choke carburetors have a choke hot air inlet adapter and choke cold air pick-up connector.

The main body contains the temperature compensated accelerator pump (Fig. 2). The temperature compensated pump has a thermostatic disc designed to open and close within a specified temperature range. As the disc warms to a temperature of 71°F and above, it uncovers a calibrated pump bleed hole, permitting a portion of the fuel to be returned to the fuel bowl during the pump stroke. As the carburetor temperature drops to 49°F and below, the disc covers the pump bleed and the maximum pump volume is once again delivered to the engine. The main body

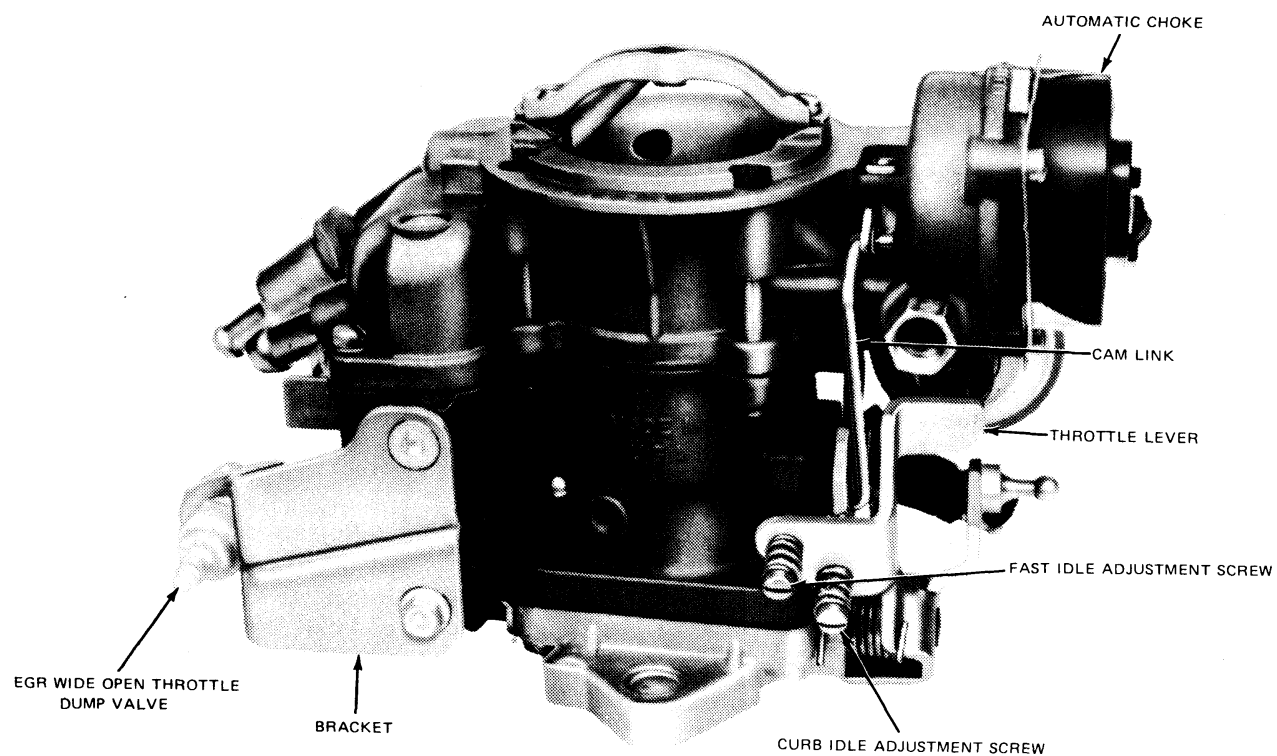
also contains the metering rod, main metering jet, low-speed jet, accelerator pump check ball and weight, an antipercolator bleed, and the main discharge nozzle. An EGR Wide Open Throttle (WOT) dump valve and bracket assembly is attached to the main body.

A vacuum operated throttle kicker is bracket mounted to the main body.

The throttle body contains the throttle plate, throttle shaft and lever and idle mixture adjusting screw with a plastic limiter cap. A mechanical fuel bowl vent operating lever is attached to the throttle lever. An EGR WOT dump valve lever is also attached to the throttle shaft.

The engine speed is regulated and controlled by the amount of fuel and air delivered to the cylinders for all engine operating conditions. Operation is based on the principle of pressure differences.

Air is drawn into the carburetor air horn by manifold vacuum. As the air passes through the carburetor on the way to enter the cylinders, low pressure is created at the fuel discharge outlets of the carburetor. The fuel bowl is vented to the carburetor air horn. The higher air pressure exerted on the fuel in the bowl forces the fuel to travel up through the fuel discharge channels and out into the air stream passing through the carburetor. The fuel and air is mixed at this point and distributed into the engine cylinders for combustion.



V2730-2A

FIG. 1 YFA 1-V Carburetor—Rear View

ADJUSTMENTS

Most carburetor adjustments are factory set, and based on guidelines determined for reduced engine emission. In order to adjust:

Automatic Choke and Electric Assist

Idle Speeds

Fuel Mixture

Idle CO

you must refer to Engine Emission Control System Part 29-01 of this manual, or Part 50-29 of the Pre-Delivery, Maintenance and Lubrication manual, or Truck Performance Specifications Book.

Adjustment points for the YFA 1-V Carburetor are shown in Figs. 1 and 3.

FAST IDLE CAM INDEX SETTING

1. Position the fast idle screw on the kickdown step of the fast idle cam and against the shoulder of the high step (Fig. 3).
2. Adjust by bending the fast idle camlink to obtain the specified clearance in Truck Performance Specifications Book, between the lower edge of the choke plate and the carburetor bore.

FAST IDLE SPEED

The fast idle adjustment screw contacts one edge of the fast idle cam. The cam permits a faster engine idle

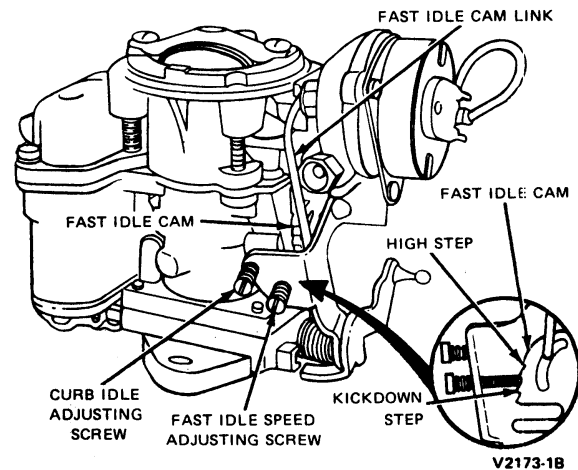


FIG. 3 Fast Idle Adjusting Screw

speed for smoother running when the engine is cold during choke operation. As the choke plate is moved through its range of travel from the closed to the open position, the fast idle cam pick-up lever rotates the fast idle cam. Various positions on the fast idle cam permit a slower idle rpm as engine temperature rises and choking is reduced.

Make certain the curb idle speed and mixture are adjusted to specification before attempting to set the fast idle speed. Refer to Engine Emission Control Systems Part 29-01 of this manual or Part 50-29 of the Pre-Delivery, Maintenance and Lubrication manual.

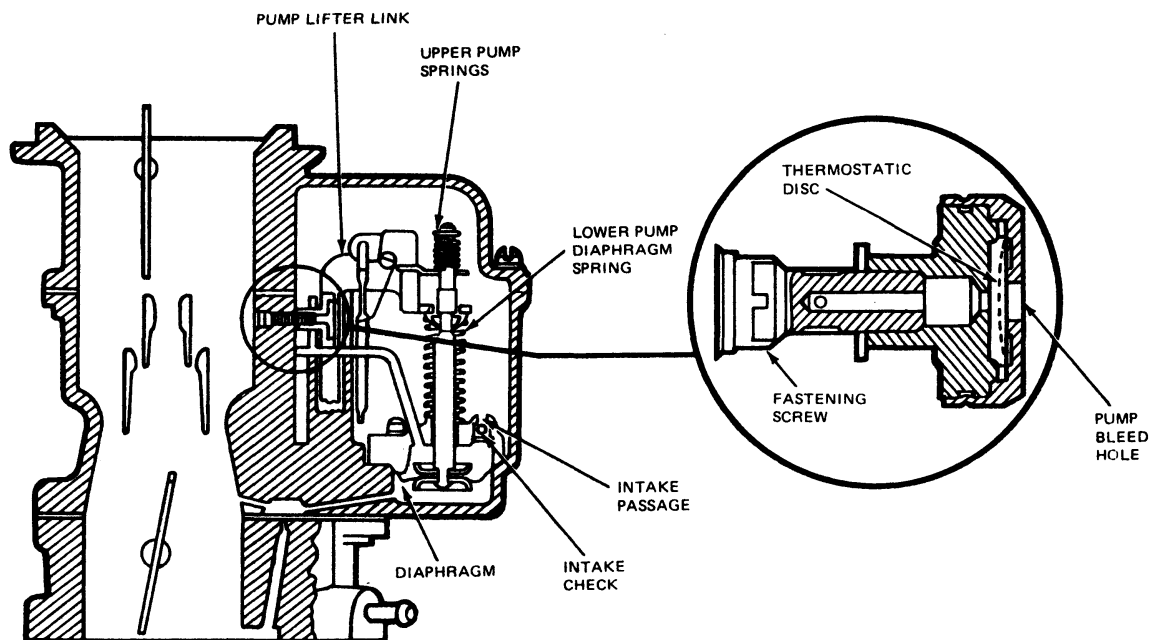


FIG. 2 Temperature Compensated Accelerator Pump System

AUTOMATIC CHOKE CARBURETOR

1. With the engine operating temperature normalized (hot), air cleaner removed and a tachometer attached, manually rotate the fast idle cam until the fast idle adjusting screw rests on the specified step of the cam.
2. Turn the fast idle adjusting screw (Fig. 2) inward or outward to obtain the specified rpm.

When setting fast idle speed, all vacuum distributor and EGR controls must be by-passed to insure proper speeds during cold operation. This can be achieved through the use of a jumper hose from the carburetor DIST port to the vacuum advance port on the distributor. The EGR vacuum source should be disconnected and plugged during the adjustment.

VACUUM OPERATED THROTTLE KICKER

The throttle kicker is used on over 8500 lb GVW 50-state carburetors. For maintenance and adjustment procedures, refer to Part 29-02, SSD-9—Emission Subsystem, Decel Throttle Control System.

AUTOMATIC THERMOSTATIC SPRING HOUSING

The automatic choke has an adjustment to control its reaction to engine temperature. By loosening the clamp screws that attach the thermostatic spring housing to the choke housing, the spring housing can be turned to alter the adjustment. Refer to specifications for the proper setting.

1. Remove the air cleaner assembly from the carburetor.
2. Loosen the thermostatic spring housing retaining screws. Set the spring housing to the specified index mark and tighten the attaching screws.
3. If other carburetor adjustments are not required, install the air cleaner assembly on the carburetor.

DECHOKE ADJUSTMENT

1. Remove the air cleaner assembly.
2. Hold the throttle plate fully open and close the choke plate as far as possible without forcing it. Use a drill of the proper diameter to check the clearance between the choke plate and air horn (Fig. 4).
3. If the clearance is not within specification, adjust by bending the arm on the choke trip lever of the throttle lever. Bending the arm downward will decrease the clearance, and bending it upward will increase the clearance. Always recheck the clearance after making any adjustment.

CHOKE PLATE PULLDOWN

1. Remove the air cleaner assembly, then remove the choke thermostatic spring housing and heat baffle from the carburetor.
2. Bend a 0.026 in. diameter wire gauge at a 90 degree angle approximately 1/8 inch from one end. Insert the bent end of the gauge between the choke piston slot and the right hand slot in the

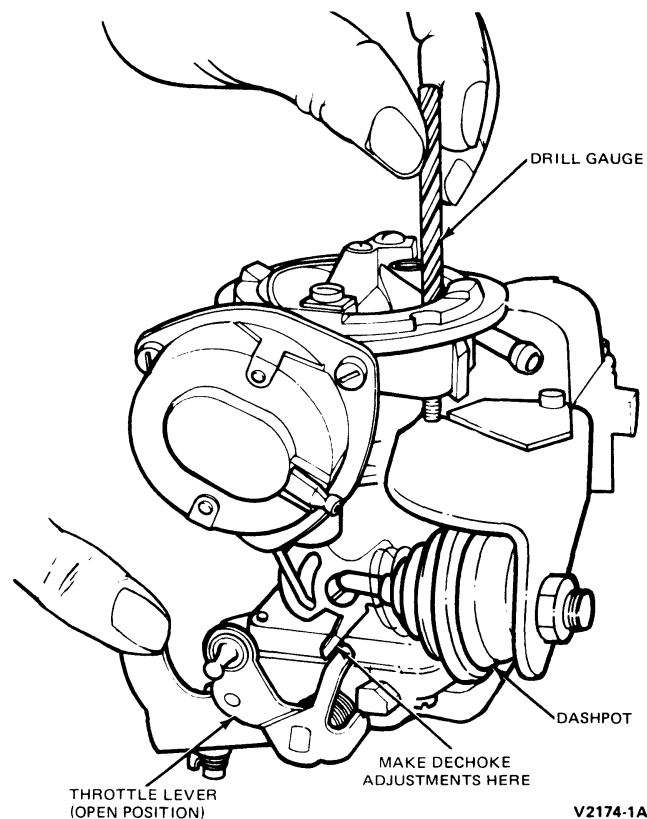


FIG. 4 Choke Plate Clearance Adjustment (Dechoke)

choke housing. Rotate the choke piston lever counterclockwise until the gauge is snug in the piston slot (Fig. 5).

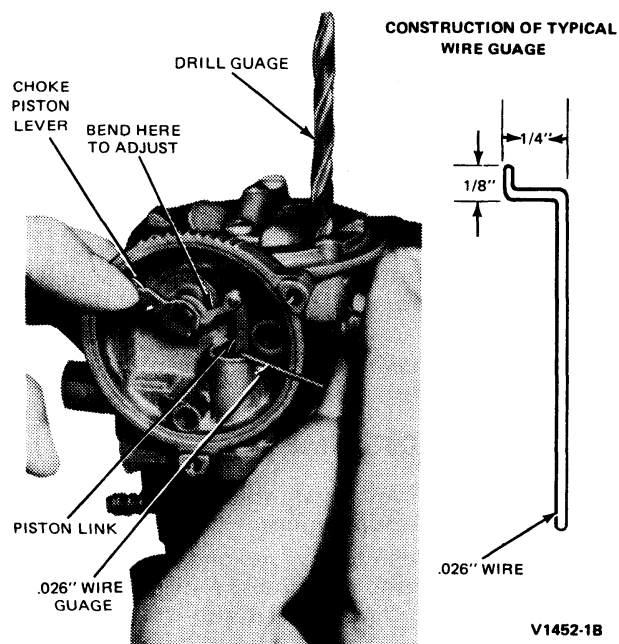


FIG. 5 Pulldown Clearance Adjustment—Model YFA 1-V Carburetor

3. Exert a light counterclockwise pressure on the choke piston lever to hold the gauge in place, then use a drill with a diameter equal to the specified pulldown clearance between the lower edge of the choke plate and the carburetor bore to check clearance (Fig. 5).
4. To adjust the choke plate pulldown clearance, bend the choke piston lever as required to obtain the specified setting. **When bending the lever, be careful not to distort the piston link.**
5. Install the choke thermostatic spring housing baffle plate and gasket. Set the housing to specifications.

METERING ROD ADJUSTMENT

1. Remove the carburetor air horn and gasket from the carburetor.
2. Back out the idle speed adjusting screw until the throttle plate is closed tight in the throttle bore.
3. Press down on the end of the pump diaphragm shaft until the assembly bottoms.
4. To adjust the metering rod, hold the diaphragm assembly as in Step 3, then, turn the rod adjustment screw counterclockwise (Fig. 6) until the metering rod just bottoms in the body casting.

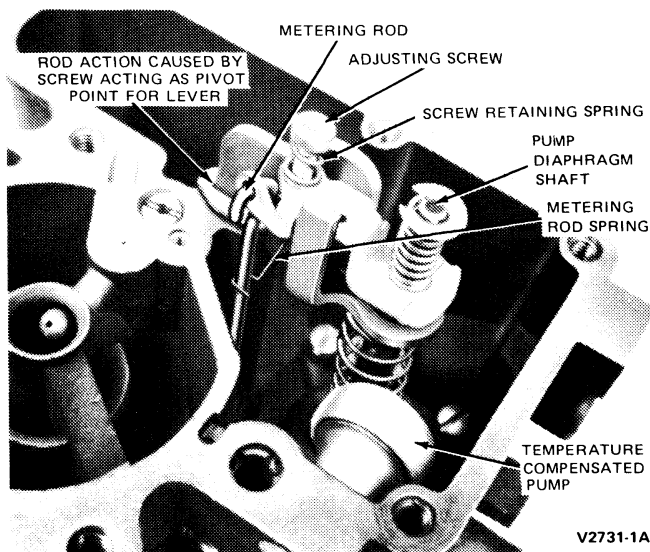


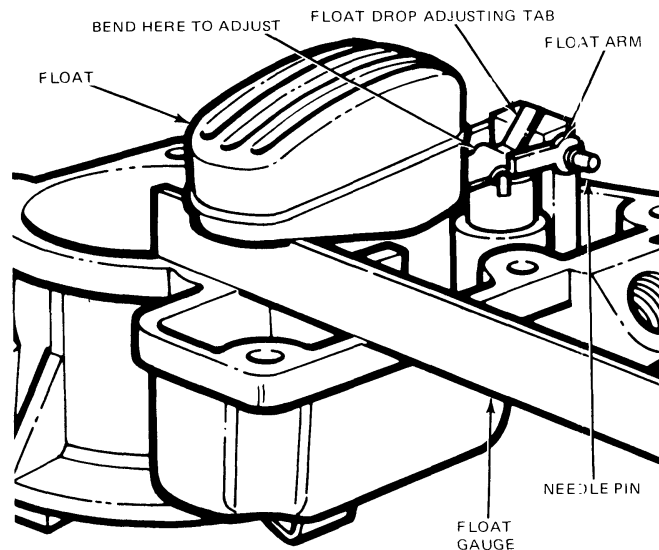
FIG. 6 Metering Rod Adjustment

5. Turn the metering rod adjustment screw in (clockwise) **one additional turn** for the final adjustment.
6. Install the carburetor air horn with a new gasket on the carburetor.

FLOAT LEVEL ADJUSTMENT

The dry float fuel level adjustment is a final float or fuel level adjustment.

1. Remove the carburetor air horn and gasket from the carburetor. Refer to Air Horn to Main Body Gasket Replacement for the proper procedure.
2. Fabricate a float level gauge (Fig. 7) to the specified float level dimension.
3. Invert the air horn assembly, and check the clearance from the float indentation on the top of



V2079-1B

FIG. 7 Fuel Level Float Adjustment

the float to the bottom of the air horn with the float level gauge (Fig. 7). Hold the air horn at eye level when gauging the float level. The float arm (lever) should be resting on the needle pin. **Do not load the needle when adjusting the float. Bend the float arm as necessary to adjust the float level (clearance). Do not bend the tab at the end of the float arm.** It prevents the float from striking the bottom of the fuel bowl when empty.

4. Install the carburetor air horn and a new gasket on the carburetor. Refer to Carburetor Air Horn to Main Body Gasket Replacement for the proper procedure.

FLOAT DROP ADJUSTMENT

1. Remove the carburetor air horn and gasket from the carburetor. Refer to Air Horn to Main Body Gasket Replacement for the proper procedure.
2. Fabricate a float drop gauge to the specified dimension (refer to Truck Performance Specification Book).
3. Hold the air horn upright and let the float hang free. Measure the maximum clearance from the toe end of the float to the casting surface (Fig. 8). Hold the air horn at eye level when gauging the dimension.
4. To adjust, bend the tab at the end of the float arm to obtain the specified setting.
5. Install the carburetor air horn and a new gasket on the carburetor as described in this Part.

MECHANICAL FUEL BOWL VENT ADJUSTMENT

To adjust the mechanical fuel bowl vent, the engine idle rpm must be set to specification and the engine at normal operating temperature.

1. Open the throttle lever so that the throttle lever actuating lever does not touch the fuel bowl vent rod (Fig. 9).

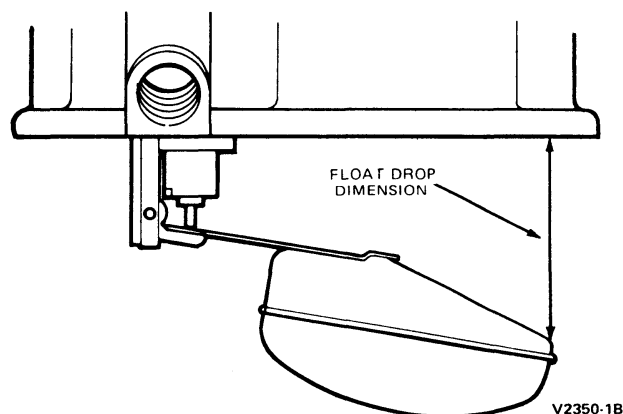


FIG. 8 Float Drop Adjustment

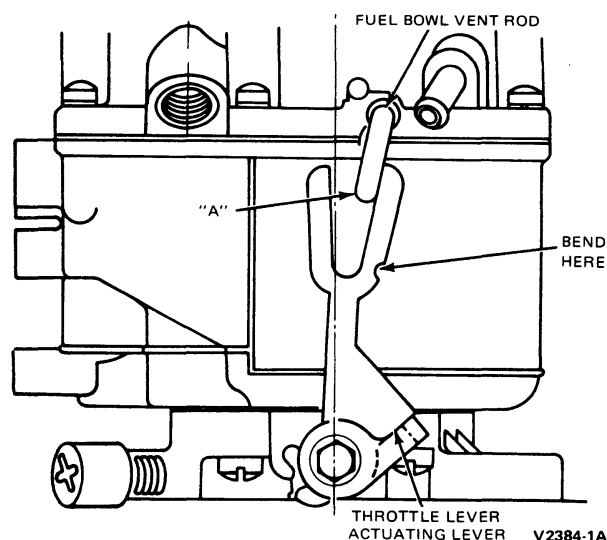


FIG. 9 Mechanical Fuel Bowl Vent Adjustment

2. Close the throttle lever to the idle set position and measure the travel of the fuel bowl vent rod at point "A". The distance measured represents the travel of the vent rod from where there is no contact with the actuating lever to where the actuating lever moves the vent rod to the idle set position. The travel of the vent rod at point "A" should be .100 to .150 inch.
3. If adjustment is required, bend the throttle actuating lever at notch shown.

EGR WIDE OPEN THROTTLE (WOT) DUMP VALVE ADJUSTMENT

See Truck Diagnostic and Maintenance Part in Group 29.

REMOVAL AND INSTALLATION

AIR HORN TO MAIN BODY GASKET

MANUAL CHOKE CARBURETOR

Removal

1. Remove the air cleaner.
2. Disconnect the choke rod at the choke lever and shaft on the carburetor air horn and the vent line to cannister (if so equipped) (Fig. 10).
3. Disengage the choke cable connecting retainer from the cable clamp and remove the cable from the choke lever. Remove the air horn assembly attaching screws, dashpot and bracket assembly and air horn gasket. Discard the gasket.

Installation

1. Install a new air horn to main body gasket. **Make sure all holes in the new gasket have been properly punched and that no foreign material has adhered to the gasket.** Install the air horn assembly, connect vent line to cannister (if so equipped), and bracket assembly and install the air

horn attaching screws, choke cable. Make sure the mechanical bowl vent rod is engaged with the forked actuating lever (if so equipped).

2. Install the air cleaner. Start the engine and run it until normal operating temperature is reached. Adjust the idle speed and fuel mixture. (Refer to Part 29-01).

AUTOMATIC CHOKE CARBURATOR

Removal

1. Remove the air cleaner.
2. Disconnect the choke heat tube at the carburetor air horn. Disconnect the fuel inlet line at the carburetor. Disconnect the choke clean air tube (Fig. 10).
3. Disconnect the electric choke wire at the connector (if so equipped).
4. Remove the wire clip retaining the link joining the fast idle choke lever to the fast idle cam and remove the link. Remove the air horn assembly attaching

screws, dashpot and bracket assembly and air horn gasket. Discard the gasket.

Installation

1. Install a new air horn to main body gasket. **Make sure all holes in the new gasket have been properly punched and that no foreign material has adhered to the gasket.** Install the air horn assembly, connect vent line to cannister (if so equipped), and bracket assembly and air horn attaching screws. Position the link joining the fast idle cam to the fast idle choke lever and retain in place with the wire clip. Make sure the mechanical fuel bowl vent rod is engaged with the forked actuating lever (if so equipped).
2. Connect the fuel inlet line and choke heat tube to the carburetor air horn. Connect the choke clean air tube.
3. Connect the electric choke wire (if so equipped).
4. Install the air cleaner. Start the engine and run it until normal operating temperature is reached. Adjust the idle fuel mixture and idle speed. (Refer to Part 29-01).

FLOAT OR NEEDLE VALVE

Removal

1. Remove the carburetor air horn and gasket. Follow instructions under Air Horn to Main Body Gasket Replacement.
2. Hold the air horn assembly bottom side up, and remove the float pin and float and lever assembly (Fig. 9). Turn the air horn assembly over and catch the needle pin, spring and needle.
3. Remove the needle seat and gasket.

Installation

1. Inspect the float assembly and float hinge shaft for signs of wear. If the float needle valve contact surface or the shaft are grooved or uneven, replace them.
2. Install the needle seat and gasket in the air horn. With the air horn inverted, install the needle, pin spring, needle pin, float and lever assembly and float pin (Fig. 7).
3. Adjust the float level to specifications.
4. Install the carburetor air horn and gasket.

CARBURETOR ASSEMBLY

Removal

Flooding, stumble on acceleration and other performance complaints are in many instances, caused by the presence of dirt, water or other foreign matter in the carburetor. To aid in diagnosing the cause of complaint, the carburetor should be carefully removed from the engine without removing the fuel from the bowl. The contents of the bowl may then be examined for contamination as the carburetor is disassembled.

1. Remove the air cleaner.
2. Remove the throttle cable or rod from the throttle lever. Disconnect the distributor vacuum line, in-line fuel filter choke heat tube and the EGR WOT dump valve hose at the carburetor.

3. Disconnect the electric choke wire at the connector.
4. Disconnect the choke clean air line and fuel bowl vent hose from the air horn.
5. Remove the carburetor retaining nuts: then remove the carburetor. Remove the carburetor mounting gasket, spacer (if equipped) and lower gasket, from the intake manifold.

Installation

1. Clean the gasket mounting surfaces of the spacer and carburetor. Place the spacer between two new gaskets and position the spacer and gaskets on the intake manifold. Position the carburetor on the spacer and gasket and secure it with the attaching nuts.
To prevent leakage, distortion or damage to the carburetor body flange, snug the nuts; then, alternately tighten each nut in a crisscross pattern to the specified torque. (Refer to appropriate engine Part in Group 21 of this manual.)
2. Connect the in-line fuel filter, throttle cable, choke heat tube, distributor vacuum line and EGR vacuum line and EGR WOT dump valve hose.
3. Connect the choke clean air line and the fuel bowl vent hose to the air horn. Connect the electric choke wire.
4. Install the air cleaner.
5. Adjust the engine idle speed and the idle fuel mixture (Part 29-01).

MAIN METERING JET, LOW-SPEED JET, METERING ROD AND ACCELERATOR PUMP

Removal

1. Remove the carburetor from the engine as described in this Part.
2. Remove the carburetor air horn and gasket by following the instructions under Air Horn to Main Body Gasket Replacement.
3. Turn the main body casting upside down and catch the accelerating pump check ball and weight (Figs. 10 and 12).
4. Loosen the throttle shaft arm screw, and remove the arm and the pump connector link.
5. Remove the accelerator pump diaphragm housing screws. Remove the accelerator pump discharge tube. Lift out the pump diaphragm assembly, the pump lifter link, the anti-rock plate, and the metering rod as a unit (Figs. 11 and 12).
6. Disengage the metering rod arm spring from the metering rod, and remove the metering rod from the metering rod hanger assembly. **Note the location of any washers shimming either spring for proper reassembly.** Compress the upper pump spring, and remove the spring retainer. Remove the upper spring, the metering rod hanger assembly and the pump lifter link (it will be necessary to remove the throttle shaft arm and pump connector before removing the lifter link), from the pump diaphragm shaft. Compress the pump diaphragm spring. Remove the pump diaphragm spring retainer, spring and pump diaphragm assembly from the pump diaphragm housing assembly.

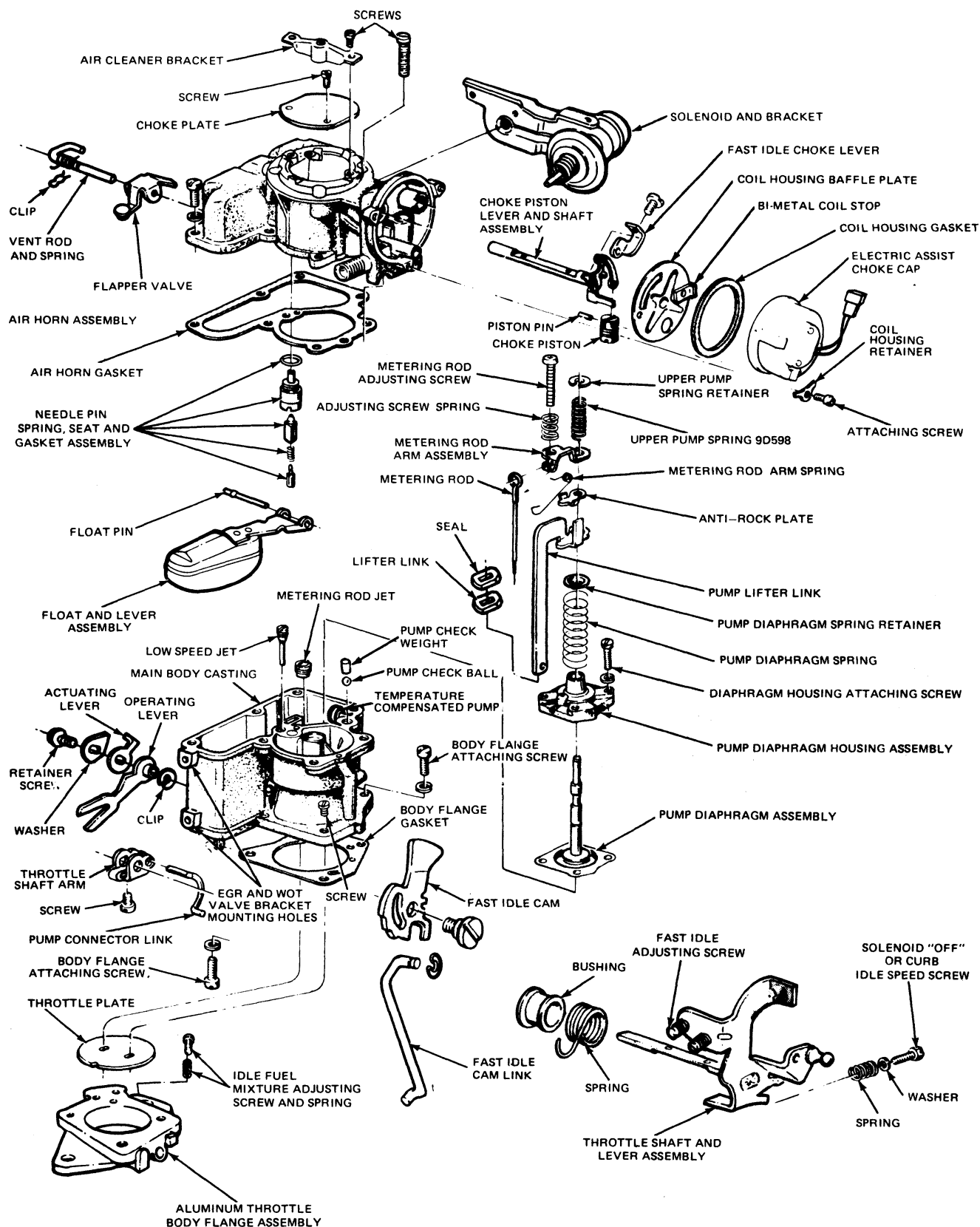
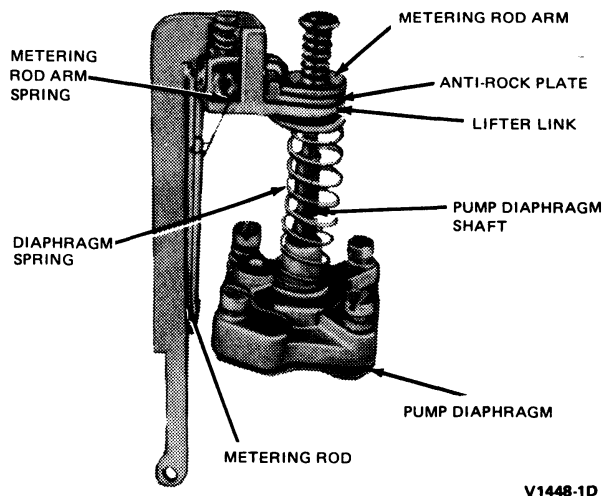
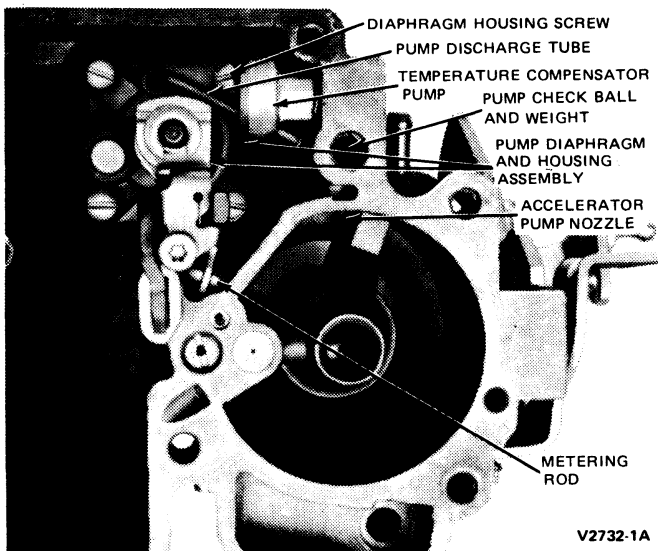


FIG. 10 Model YFA-1-V Carburetor Assembly



V1448-1D

FIG. 11 Accelerating Pump and Lifter Link Assembly



V2732-1A

FIG. 12 Pump Diaphragm and Housing Installation

7. With the proper size jet tool or screwdriver, remove the low speed jet and the main metering jet (Fig. 10).

Installation

1. With the proper size jet tool (or screwdriver) install the low speed jet and the main metering jet (Fig. 10).
2. Install the pump diaphragm in the pump diaphragm housing. Position the step-up spring on the diaphragm shaft and housing assembly. **Install the spring shim washers in the proper locations.** Install the spring retainer. Install the pump lifter link. Install the anti-rock plate, metering rod arm and spring assembly and the upper pump spring on the diaphragm shaft. Depress the spring and install the upper pump spring retainer.
3. Install the metering rod on the metering rod arm and place the looped end of the metering rod arm spring on the metering rod as shown in Fig. 10. Align the pump diaphragm with the diaphragm housing; make sure holes are aligned. Install the housing attaching screws to keep the diaphragm and housing aligned. Install the accelerator pump discharge tube.
4. Install the throttle shaft arm and link to the end of the throttle shaft.
5. Adjust metering rod as described in this Part.
6. Install the carburetor air horn and gasket as described under Air Horn to Main Body Gasket Replacement.
7. Install the carburetor on the engine as described in this Part.

DISASSEMBLY AND ASSEMBLY

Refer to Part 24-01 for Cleaning and Inspection procedures. Refer to Fig. 10 for a disassembled view of the carburetor.

CARBURETOR ASSEMBLY

Disassembly

Use a separate container for the component parts of the various assemblies to facilitate cleaning, inspection and assembly.

The following is a step-by-step sequence of operations for completely overhauling the carburetor; however, certain components of the carburetor may be serviced without a disassembly of the entire unit.

1. Remove the attaching screws and retainers, the thermostatic spring housing assembly, spring housing gasket, spring housing baffle plate and

fast idle link. Remove the EGR WOT dump valve and bracket assembly. Remove the front mounted solenoid and bracket (if so equipped).

2. Remove the air horn assembly attaching screws, solepot or throttle kicker, air horn assembly, and air horn gasket (Fig. 10).
3. Hold the air horn assembly bottom side up and remove the float pin and float and lever assembly. Turn the air horn assembly over and catch the needle pin, spring and needle.
4. Remove the needle seat and gasket.
5. Remove the air cleaner bracket. Remove the choke plate attaching screws. File the burrs from the choke shaft if necessary, and use new screws upon reassembly. Remove the choke plate from the air horn assembly; remove the choke link lever and

attaching screw. Rotate the choke shaft and piston assembly counterclockwise until the choke piston is out of the choke piston cylinder (Fig. 13). Remove the assembly from the air horn. Remove the piston pin and piston from the choke piston lever and link assembly.

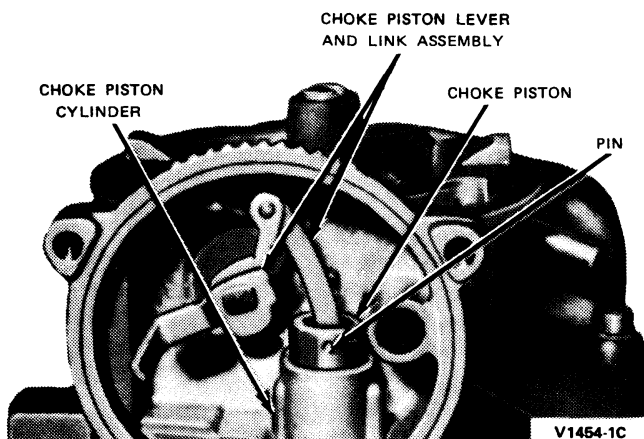


FIG. 13 Automatic Choke Piston Removal or Installation

6. Remove the spring retainer for the mechanical fuel bowl vent flapper valve. Remove the vent shaft rod and spring, and the flapper valve. Note the position of the ends of the torsion spring on the vent rod for proper installation.

Caution: Do not immerse the air horn in any cleaner or solvent. Damage to the vent shaft seal could result.

7. Turn main body casting upside down and catch the accelerating pump check ball and weight.
8. Remove the throttle shaft mechanical fuel bowl lever retaining screw at the end of the throttle shaft. Remove the operating lever spring washer, vent rod, actuating lever and E-clip.
9. Loosen the throttle shaft arm screw, and remove the arm and pump connector link.
10. Remove the fast idle cam and shoulder screw.
11. Remove the accelerating pump diaphragm housing screws. Lift out the pump diaphragm assembly, the pump lifter link, the metering rod as a unit. Remove the lifter link seal.
12. Disengage the metering rod arm spring from the metering rod, and remove the metering rod from the metering rod arm assembly. **Note the location of any washers shimming either spring for proper reassembly.** Compress the upper pump spring, and remove the spring retainer. Remove the upper spring, the metering rod arm assembly and the pump lifter link from the pump diaphragm shaft. Compress the pump diaphragm spring, and remove the pump diaphragm spring retainer, spring, and pump diaphragm assembly from the pump diaphragm housing assembly.
13. With the proper size jet tool or screwdriver, remove the main metering rod jet and the low speed jet (Fig. 10).
14. Remove the retaining screws and separate the

throttle body flange assembly from the main body casting. Remove the body flange gasket.

15. Remove the throttle plate retaining screws. File the staked ends, if necessary, and use new screws upon assembly (be sure to properly stake the screws). Slide the throttle shaft and lever assembly out of the throttle body flange assembly. **Note the location of the ends of the torsion spring on the throttle shaft for proper reassembly. When removing the idle mixture limiter cap be sure to note the position of the tab. After removing the limiter cap count the number of turns to lightly seat the needle. This information will be used in reassembly.**

Assembly

1. Install the throttle shaft and lever assembly with torsion throttle return spring and bushing (Figs. 10 and 14) in the throttle body flange. Position the throttle plate on the throttle shaft with the notch in the plate aligned with the slotted idle port (Fig. 14) in the throttle body flange. Install the throttle plate attaching screws snug, but not tight. Move the shaft back and forth and rotate it to be sure the throttle plate does not bind in the flange bore. It is necessary that the throttle plate should close tight in the bore, therefore the idle speed screw should be backed out sufficiently to insure it does not contact the throttle stop. Re-position the plate, if necessary. Tighten the screws and stake (or peen) the screws in place.

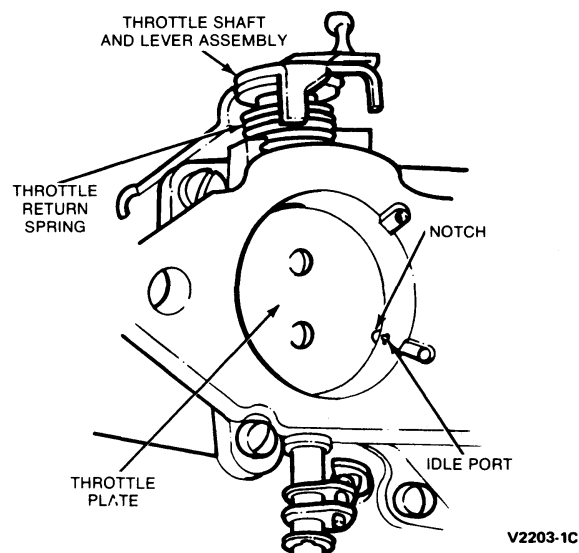


FIG. 14 Throttle Plate and Shaft Arm Installation

Install the idle mixture screw the same number of turns out from lightly seated. Install the limiter cap in the same position as removed.

2. Place a new body flange gasket and the main body casting on the throttle body flange. Install the attaching screws and tighten them evenly.
3. With the proper size jet tool (or screwdriver) install the low speed jet and the main metering rod jet (Fig. 10).
4. Install the pump diaphragm in the pump diaphragm housing (Fig. 12). Position the pump diaphragm

- spring on the diaphragm shaft and housing assembly. Install the spring shim washers in the proper locations. Install the spring retainer. Install the pump lifter link. Install the throttle shaft arm and pump connector link, metering rod arm and spring assembly, and upper pump spring on the diaphragm shaft. Depress the spring and install the upper pump spring retainer.
5. Install the metering rod on the metering rod arm and place the looped end of the metering rod arm spring on the metering rod as shown in Fig. 10. Align the pump diaphragm with the diaphragm housing; make sure the holes are aligned. Install the housing attaching screws to keep the diaphragm and housing aligned.
 6. Align the pump housing, pump lifter link, metering rod and baffle plate with the main body casting. **Be sure the vacuum passage in the diaphragm housing is aligned with the vacuum passage in the main body.** Install the assembly in the main body casting being careful to engage the pump lifter link with the lifter link seal and the main body, and to insert the metering rod in the main jet. Install the pump housing attaching screws snug, but not tight. Push down on the diaphragm shaft to compress the diaphragm, and tighten the attaching screws. Adjust the metering rod, following the procedure under Metering Rod Adjustment.
 7. Install the fast idle cam and shoulder screw. Install the throttle shaft arm and pump connector link on the throttle shaft and pump lifter link (Fig. 14). Tighten the lock screw. Install the E-clip vent rod actuating lever, spring washer, operating lever and retaining screw at the end of the throttle shaft. Tighten the retaining screw.
 8. Assemble the choke piston and pin to the choke piston lever and link assembly. Install the choke shaft assembly in the air horn and position the piston as shown in Fig. 13.
 9. Align the piston with the cylinder and rotate the shaft assembly clockwise until the piston pin is inside the piston cylinder.
 10. Position the choke plate on the choke shaft and install the screws snug. Check the choke plate movement to be sure it isn't binding. Tighten the screws. Install the choke link lever and tighten the attaching screw.
 11. Install the needle seat and gasket in the air horn. With the air horn inverted, install the needle, pin spring, needle pin, float and lever assembly, and float pin. Adjust the float level to specifications.
 12. Align the bowl vent flapper valve with the vent rod. Make sure the spring is properly installed on the vent rod shaft. Install the spring retainer.
 13. Place the pump check ball and weight in the main body casting (Figs. 10 and 12). Position a new air horn gasket, the air horn assembly, and the dashpot or solenoid bracket on the main body. Install and tighten the attaching screws. **Note: When installing the air horn assembly onto the main body, make sure the mechanical fuel bowl is engaged with the forked actuating lever.**
 14. Install the thermostatic coil housing, gasket and baffle plate, identification mark facing outward, with the gasket between the baffle and coil housing. Be sure the thermostatic spring engages the choke lever tang and is not stopped by a retaining tab on the baffle plate (if equipped). Install the retainers and housing screws. Set the choke housing index to specifications and tighten the screws.
 15. Install the air cleaner bracket. Install the fast idle link.
 16. Install the EGR WOT dump valve and bracket assembly.
 17. Install solepot or throttle kicker (if so equipped).
 18. Install front mounted solenoid (if so equipped).

SPECIFICATIONS

Adjustment procedures and service instructions for this carburetor are contained in Part 29-02 of this manual and in Part 59-29 of the Pre-Delivery, Maintenance and Lubrication Manual. Specifications are located in the Truck Performance Specifications Manual.

A typical Vehicle Emission Control Information Decal is shown below (Fig. 15). This decal is located on the engine and lists many of the specifications required for engine timing, idle, fuel mixture, etc.

CHOKE SETTING SPECIFICATION

FAST IDLE RPM SPECIFICATION

CURB IDLE RPM SPECIFICATION

Ford

FORD MOTOR COMPANY

VEHICLE EMISSION CONTROL INFORMATION

ENGINE FAMILY

ENGINE DISPLACEMENT

TRANS

SPARK PLUG GAP

CATALYST

SHIFT SCHED

IGNITION TIMING

MAX. TIMING RPM

CHOKE SETTING

FAST IDLE RPM

CURB IDLE RPM

TSP OFF RPM

SET PARKING BRAKE AND BLOCK WHEELS. DISCONNECT AUTOMATIC BRAKE RELEASE AND SENSOR CONNECTOR FROM DUAL MODE IGNITION MODULE IF SO EQUIPPED. MAKE ALL ADJUSTMENTS WITH ENGINE AT NORMAL OPERATING TEMPERATURE, A/C AND HEADLIGHTS OFF, AND AIR CLIP LAMER IN POSITION WHEN CHECKING ALL ENGINE SPEEDS. DISCONNECT AND PLUG (D.P.) THERMACTOR AIR

TRANSMISSION GEAR

NEUTRAL

DRIVE

BYPASS VALVE VACUUM HOSE AND CONNECT A VACUUM HOSE FROM MANIFOLD VACUUM TO THE BYPASS VALVE (AIR BPV).

ADJUST IGNITION TIMING AND TIMING RPM TO SPEC WITH VACUUM HOSE(S) DISCONNECTED AND PLUGGED AT THE DISTRIBUTOR IF EQUIPPED WITH A THROTTLE SOLENOID POSITIONER. DASHPOT DISCONNECT SOLENOID WIRE AND COLLAPSE THE DASHPOT. SET RPM USING CARBURETOR SET SCREW.

FAST IDLE - ADJUST RPM TO SPEC WITH TRANS IN NEUTRAL (M/T) OR PARK (A/T). FAST IDLE CAM IN SPECIFIED POSITION. D.P. EGR VALVE VACUUM HOSE AT A. D.P. PURGE VALVE VACUUM HOSE AT B.

CURB IDLE - ADJUST RPM TO SPEC WITH TRANS IN SPECIFIED MODE AND ALL VACUUM HOSES CONNECTED EXCEPT BYPASS VALVE. THROTTLE SOLENOID POSITIONER ENERGIZED AND DASHPOT COLLAPSED IF SO EQUIPPED.

TSP OFF - ADJUST RPM TO SPEC WITH THROTTLE SOLENOID POSITIONER WIRE DISCONNECTED AND THE DASHPOT COLLAPSED IF SO EQUIPPED.

IDLE MIXTURE IS PRESET AT FACTORY. NOT ADJUSTED DURING SCHEDULED MAINTENANCE.

COMPLIANCE DEMONSTRATED BELOW 4000 FT.

EVAPORATIVE FAMILY IS

VACUUM HOSE ROUTING

ADJUSTMENT PROCEDURE NOTES

THIS VEHICLE CONFORMS TO U.S.E.P.A. REGULATIONS APPLICABLE TO 1980 MODEL YEAR NEW MOTOR VEHICLES

THROTTLE SOLENOID POSITIONER OFF RPM SPECIFICATION (IF SO EQUIPPED)

V2733-2A

FIG. 15 Typical Vehicle Emission Control Information Decal

Model 2150 2-V Carburetor

PART 24-25

APPLIES TO 5.0L (302 CID) V-8, 5.8L (351 CID) V-8 AND 6.6L (400 CID)

SUBJECT	PAGE	SUBJECT	PAGE
ADJUSTMENTS	24-25-9	DISASSEMBLY AND ASSEMBLY	
Accelerating Pump Stroke	24-25-9	Automatic Choke	24-25-19
External Fuel Bowl Vent	24-25-9	Choke Pulldown Diaphragm	
Fuel Level Float — Dry	24-25-11	Assembly	24-25-19
Fuel Level Float — Wet	24-25-12	Main Body	24-25-16
DESCRIPTION		Disassembly	
Accelerator Pump System	24-25-6	Air Horn	24-25-15
Carburetor Assembly	24-25-1	Automatic Choke	24-25-15
Enrichment System	24-25-7	Choke Pulldown Diaphragm	
Fuel Inlet System	24-25-5	Assembly	24-25-15
High Speed Pullover System	24-25-7	Main Body	24-25-15
Idle System	24-25-5	REMOVAL AND INSTALLATION	
Main System	24-25-6	Accelerator Pump Diaphragm	
Operation Choke System	24-25-3	and/or Elastomer Valve	24-25-14
Tamper-Resistant Features	24-25-8	Air Horn to Main Body Gasket	24-25-13
Throttle Positioners	24-25-7	Carburetor Assembly	24-25-12
Variable High Speed		Choke Pulldown Diaphragm	
Bleed System	24-25-6	Assembly	24-25-14
DIAGNOSIS AND TESTING	24-25-9	Float, Needle Valve and Seat,	
		Inlet Screen or Main Jets	24-25-13
		SPECIFICATIONS	24-25-20

DESCRIPTION

CARBURETOR ASSEMBLY

The Motorcraft Model 2150-2V carburetor has two main assemblies; the air horn and the main body (Figs. 1, 2 and 3).

The air horn assembly which serves as the main body cover contains the choke plate, the fuel bowl vent valve or fuel bowl vent tube (if so equipped), the hot idle compensator. It also contains the pullover enrichment system which provides additional fuel flow at high air flow through the air horn.

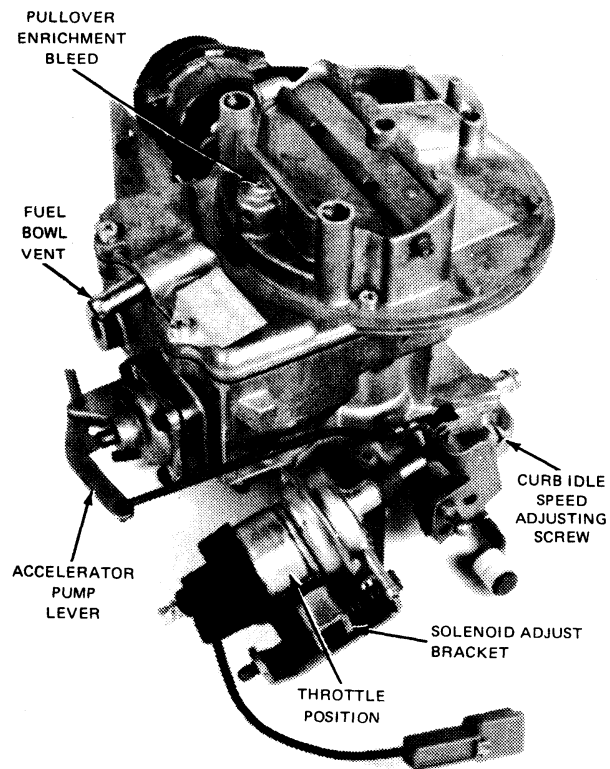
Some carburetors are equipped with altitude compensation to improve high altitude emission control and driveability. These applications have a bypass air intake in the air horn of the carburetor. A small choke plate called the bypass choke is connected to the main

choke with a link between the choke plate shaft levers (Figs. 1 and 2).

The main body assembly has the throttle plate, the accelerator pump assembly, the enrichment valve assembly, the fuel bowl, and the float and lever assembly. Each bore contains a main and booster venturi, a main fuel discharge, accelerator pump discharge, idle fuel discharge and throttle plate.

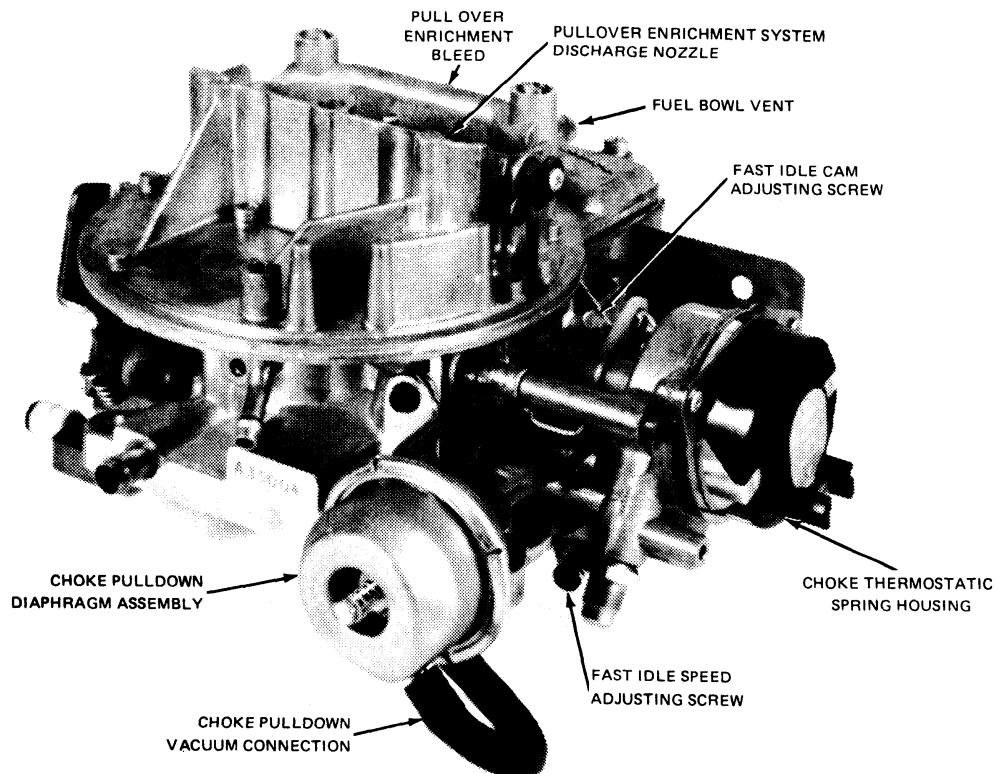
On some applications, the booster venturi contains the variable high speed bleed control system which allows control of air/fuel mixture for improved high speed operation and low speed response.

The choke pulldown diaphragm, the choke housing and the choke cap which houses the choke bimetal are attached to the main body. This system functions simultaneously to provide a rich air/fuel mixture for starting and operating a cold engine.



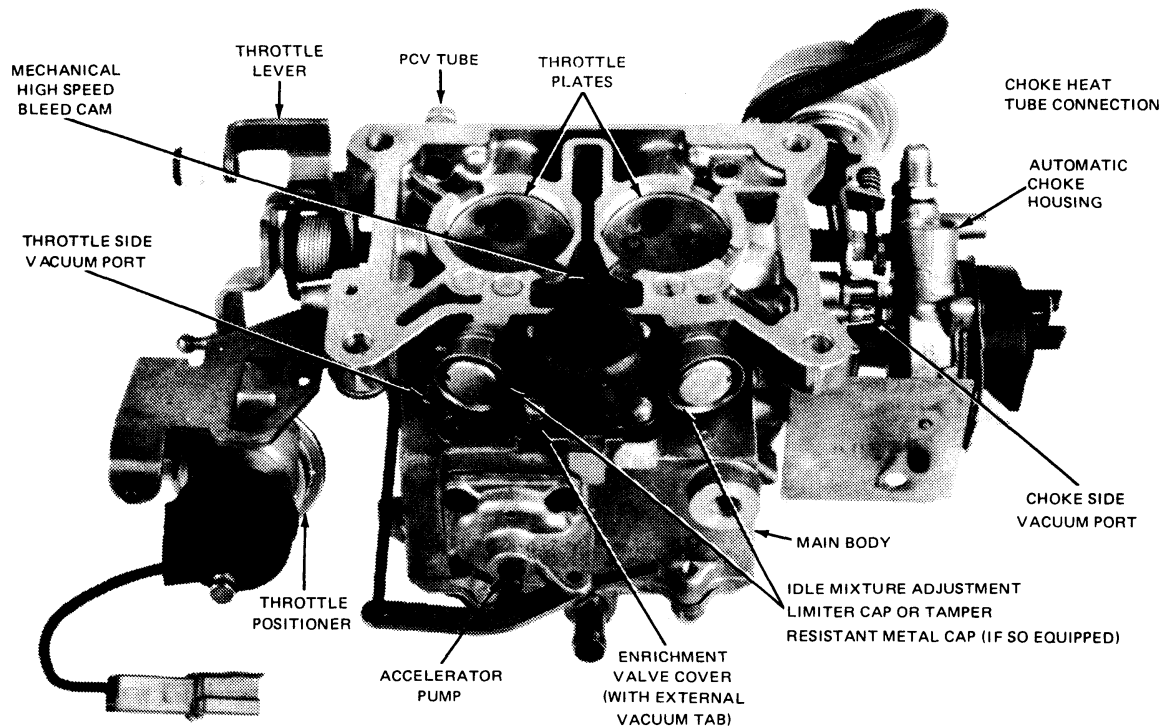
V2752-1A

FIG. 1 Model 2150 2-V Carburetor—Left Front 3/4 View with Altitude Compensation



V2753-2A

FIG. 2 Model 2150 2-V Carburetor without Altitude Compensation



V2754-2A

FIG. 3 Model 2150 2-V Carburetor—Bottom View

OPERATION CHOKE SYSTEM

The 2150-2V truck applications have a hot air choke with some applications including an electric assist choke cap. The system consists of the choke pulldown diaphragm, the choke housing with the hot air passage, and the electric assist choke cap (if equipped).

Following the recommended starting procedure, the accelerator pedal is depressed to the floor. This allows the choke plate to close by the closing force exerted on it by the choke bimetal. At temperatures below 24°C (75°F) on most applications, more bimetal tension holds the choke plate closed tighter.

When the engine starts, a leaner air/fuel mixture is required. The pulldown diaphragm assembly provides proper choke plate opening for the engine during this time by manifold vacuum acting on the diaphragm in the pulldown assembly. A link which is connected to the diaphragm pulls the choke plate open a specified amount.

This action is called choke pulldown and is measured by a reference hardgauge specification. The adjustment procedure is found in Parts 29-02 and 50-29 under Automatic Choke Systems.

The choke bimetal unwraps as it is affected by heat. As this occurs, the choke plate opens at an increased rate. Also, the fast idle cam is allowed to fall to a lower step when the throttle is cycled or upon acceleration which reduces engine idle speed.

Depending on application, several types of choke pulldown diaphragms are available. They include

“modulated” choke pulldown and positive choke closure (PCC).

The “modulated” choke pulldown assembly incorporates an additional spring which allows choke plate movement when necessary under certain cold engine requirements (Fig. 4).

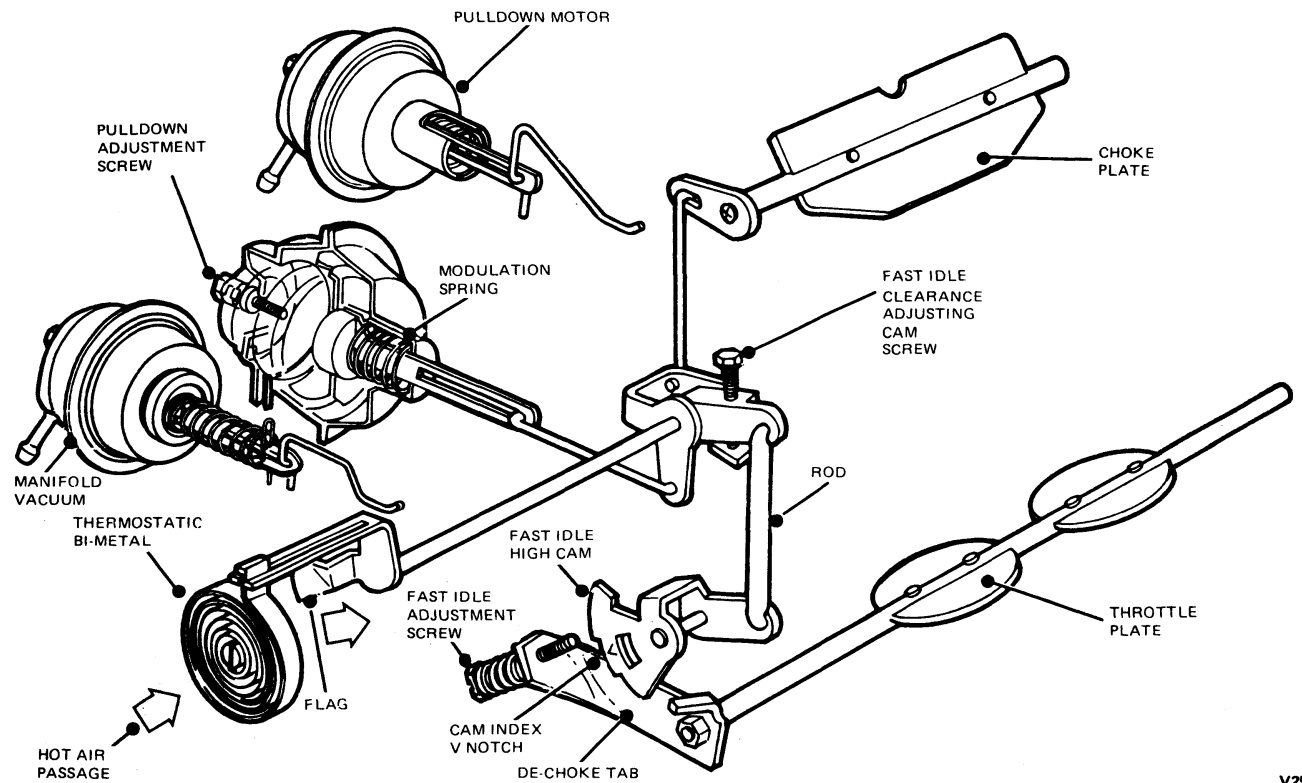
Positive choke closure (PCC) also incorporates a spring, but it is on the outside of the choke pulldown link. This spring provides additional force to hold the choke plate closed under cranking conditions (Fig. 4).

The hot air choke with the electric assist choke cap functions as follows: as the engine warms up, manifold heat transmitted by hot air to the choke housing relaxes the bimetal permitting the choke to open. The electric assist has a ceramic heating pill. At temperatures above 12°C (54°F) to 23°C (74°F), the temperature sensing switch closes and current is supplied to the heater causing the bimetal to pull the choke plate open at an increased rate (Fig. 5 and 6).

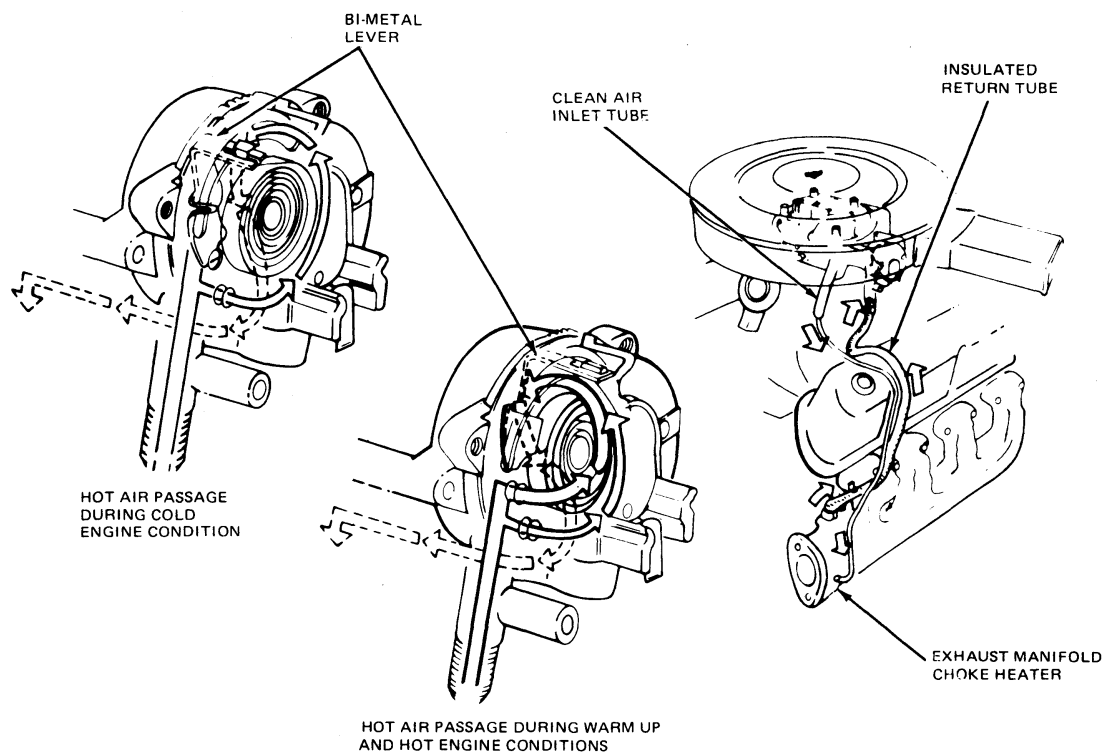
The electric assist choke cap is powered from the stator tap of the alternator.

Testing the electric assist choke cap is covered in Part 29-02 and 50-29.

Some 2150-2V truck applications have a riveted choke cap installation to prevent choke mis-adjustment. The procedure for removal of the rivets is found in Part 29-02 and 50-29 under Choke Systems.

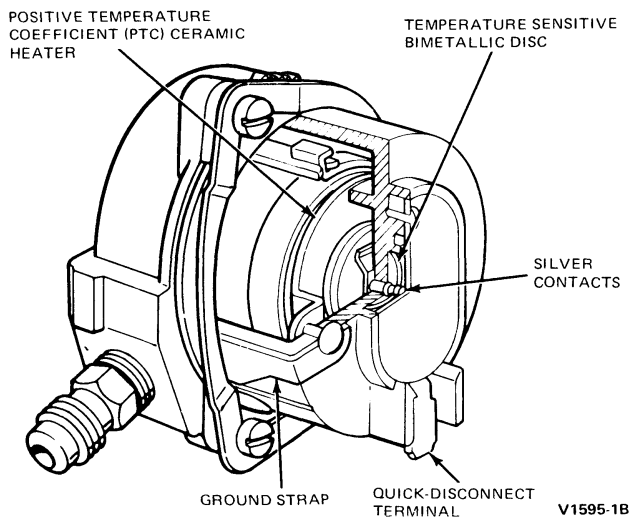


V2579-B

FIG. 4 Choke Pulldown Assemblies

V2456-2A

FIG. 5 Choke Hot Air Passage



**FIG. 6 Typical Electric Assisted Choke System—
Model 2150 2-V Carburetor**

FUEL INLET SYSTEM

The amount of fuel entering the fuel bowl (Fig. 7) is regulated by the distance the fuel inlet needle is raised off its seat and by fuel pump pressure. Movement of the fuel inlet needle in relation to the seat is controlled by the float and lever assembly which rises and falls with the fuel level. When the fuel in the fuel bowl reaches a pre-set level, the float lowers the fuel inlet needle to a position where it restricts the flow of fuel, admitting only enough fuel to replace that being used.

On some applications, a bowl filler occupies the space on the left side of the fuel bowl above the fuel level and prevents the fuel from moving into that area on right hand turns. By doing so, the fuel level above the main jets is maintained and the required fuel air mixture is delivered to the engine.

A retaining clip is attached to the fuel inlet needle assembly. The clip hooks over the tab on the end of the lever of the float assembly. This clip assures reaction of the fuel inlet needle to any downward movement of the float. Downward movement of the float (or float drop) is controlled by adjustment of the tab end of the float lever. A wire-type retainer prevents movement of float shaft within the guides on each side of the fuel bowl. The retainer fits into a groove on the outside of the fuel inlet needle seat. The ends of the retainer are hooked over grooves on opposite ends of the float shaft. The fuel bowl is internally vented to the air cleaner and externally vented to the carbon canister.

IDLE SYSTEM

The difference in pressure between the fuel bowl and the curb idle discharge ports forces fuel through the idle system. Fuel flows from the fuel bowl through the main jets and into the main wells as shown in Fig. 8. From the main wells the fuel flows up the idle tubes through short diagonal passages in the booster venturi assembly into the idle down channels in the main body. Calibrated restrictions at the lower end of the idle tubes meter the flow of fuel. Air first enters the idle system through idle anti-syphon bleeds at the upper end of the

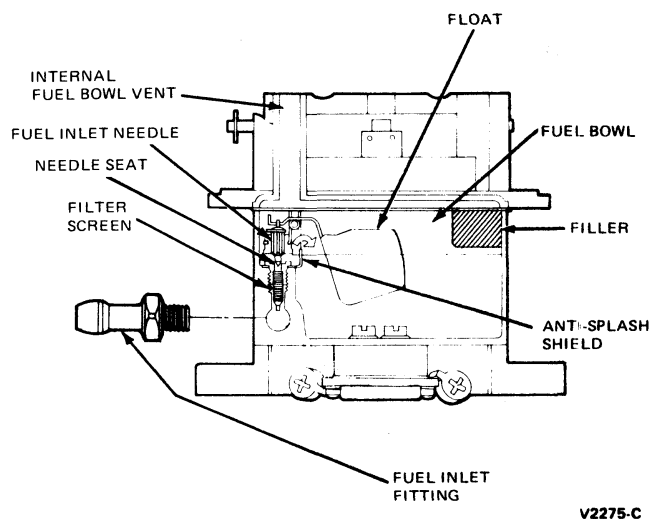


FIG. 7 Fuel Inlet System

idle tubes. These air bleeds also act to prevent syphoning when the engine is stopped. Additional air enters the system through the idle air bleeds located in the main body adjacent to the booster venturi. The fuel air mixture continues through the idle down channels past the idle down channel restrictors. At curb idle additional air from the idle transfer slots mixes with the fuel just before it enters the engine through the curb idle discharge ports below the throttle plate. The amount of this mixture that enters the engine is controlled by the tapered idle mixture adjusting screws which protrude into the curb idle discharge ports and vary the effective metering area of the ports.

Some applications have "capped" or tamper-resistant idle mixture adjusting screws, unlike the plastic caps found on most applications, the new caps are two part cap and plugs (Fig. 16). The removal procedure for the cap and plug is found in the idle mixture adjustment procedure Part 29-02 and Part 50-29.

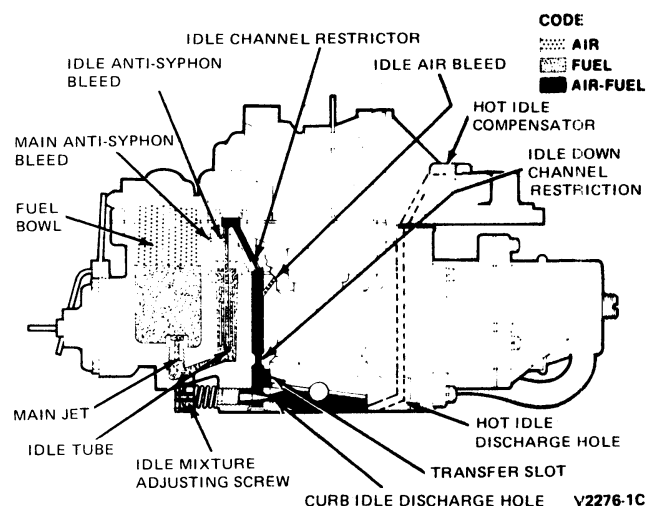


FIG. 8 Idle System

During off-idle when the throttle plates are moved slightly past the idle transfer slots the slots begin

discharging fuel as they are exposed to manifold vacuum. These transfer slots allow a smooth transition from the idle to the main fuel metering system. As the throttle plates are opened still wider, and the engine speed increases, the air flow through the carburetor also increases. This creates a vacuum in the booster venturi strong enough to bring the main fuel system into operation. Fuel flow from the idle system tapers off as the main fuel system begins discharging fuel.

On some model carburetors, a hot idle compensator (HIC) is mounted in the air horn (Fig. 8). A bimetal strip opens a valve to admit air below the throttle plates, to increase hot engine idle speeds and thereby increase coolant flow to prevent the engine from overheating.

ACCELERATOR PUMP SYSTEM

Upon acceleration, the air flow through the carburetor responds almost immediately to the increased throttle opening. There is, however, a brief interval before the flowing fuel, which is heavier than air, can gain the required flow speed to maintain the desired balance of air and fuel.

During this interval, the accelerator system, shown in Fig. 9 supplies fuel until the other systems can once again provide the proper mixture. When the throttle is closed, the diaphragm return spring forces the diaphragm toward the cover, drawing fuel into the chamber through the inlet. The inlet has an Elastomer valve which uncovers the inlet hole to admit fuel from the fuel bowl. The valve covers the inlet hole when the accelerator pump is operated to prevent the fuel from returning to the bowl. A discharge weight and ball check prevents air from entering from the discharge nozzle when fuel is drawn into the diaphragm chamber. When the throttle is opened, the diaphragm rod is moved inward, forcing fuel from the chamber into the discharge passage. Fuel, under pressure, forces the pump discharge weight and ball off their seat, and fuel passes through the accelerator pump discharge screw and is sprayed into each main venturi through discharge ports. An air bleed in the wall of the accelerator pump fuel chamber prevents vapor entrapment and pressure buildup in the diaphragm chamber. When the pump is activated this bleed hole also allows a calibrated amount of fuel to return to the fuel bowl. The pump bleed size is a factor in determining total pump discharge capacity.

VARIABLE HIGH SPEED BLEED SYSTEM

The variable high-speed bleed system provides close control over fuel mixture by providing a direct link between air-fuel ratio and throttle plate position. This allows control of air/fuel mixture to the booster venturi for more precise high speed operation and improved low-speed response. When the throttle plate is closed, the cam does not contact lift rod. When the throttle starts to open the cam engages the lift rod which raises the tapered metering rods in the high-speed bleed hole. Raising the metering rods decreases air flow through the high-speed bleed orifices. This causes a richer mixture. The lift rod is factory adjusted and should not be field adjusted (Fig. 10).

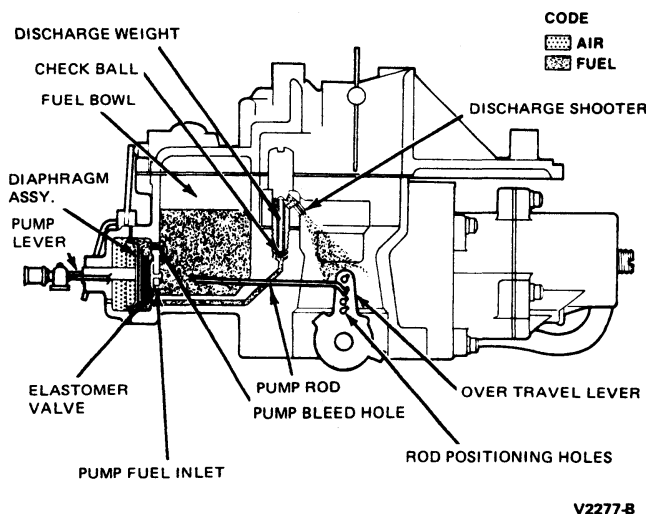


FIG. 9 Accelerator Pump System

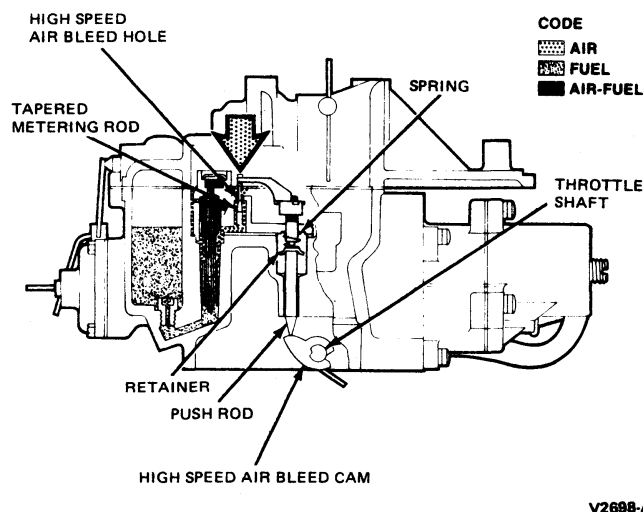


FIG. 10 Variable High Speed Bleed System

MAIN SYSTEM

As engine speed or load increases, the air passing through the booster venturi creates an increase in vacuum. This vacuum or difference in pressure between the main discharge ports in the booster venturi and the fuel bowl causes fuel to flow. Fuel travels up the main well tubes and is mixed with air from the anti-syphon and high speed bleeds which enters the fuel stream through holes in the main well tubes. The high speed bleeds meter a decreasing amount of air as the throttle plate opening and air flow through the carburetor increases maintaining the required air fuel ratio. The anti-syphon bleeds also act as vents to prevent syphoning when the engine is shut down. The mixture of fuel and air is desirable because it is lighter than raw fuel and responds to faster changes in venturi vacuum. It also atomizes more readily than raw fuel. The air fuel mixture is discharged through the main discharge nozzles in the booster venturi where it is mixed with the air flowing through the carburetor. The throttle plates control the amount of the air fuel mixture admitted to

the intake manifold regulating the speed and power output of the engine (Fig. 11).

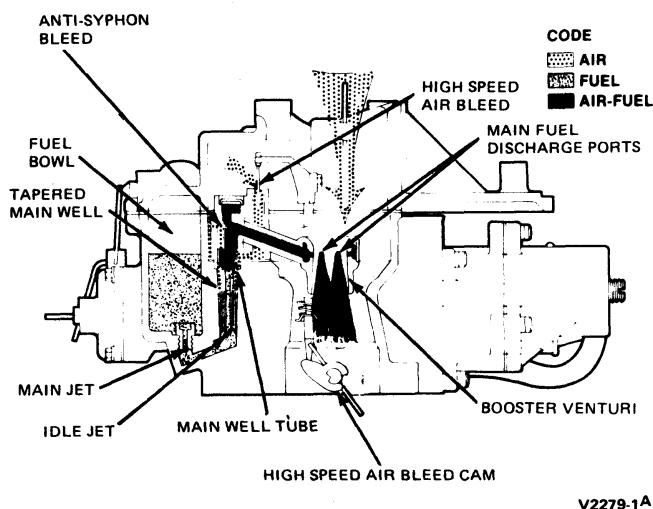


FIG. 11 Main Fuel System

HIGH SPEED PULLOVER SYSTEM

The high speed pullover system (Fig. 12) consists of an air bleed located in a raised boss in the front of the air horn, a connecting discharge nozzle for each venturi, and a tube with a calibrated orifice at the lower end. The tube extends from the air horn into the fuel bowl. At high speeds the air flow through the carburetor creates a vacuum at the discharge nozzles causing fuel to be pulled up the tube. The fuel is mixed with air from the air bleed and discharged into the air stream as it enters the carburetor to provide additional fuel for high speed operation.

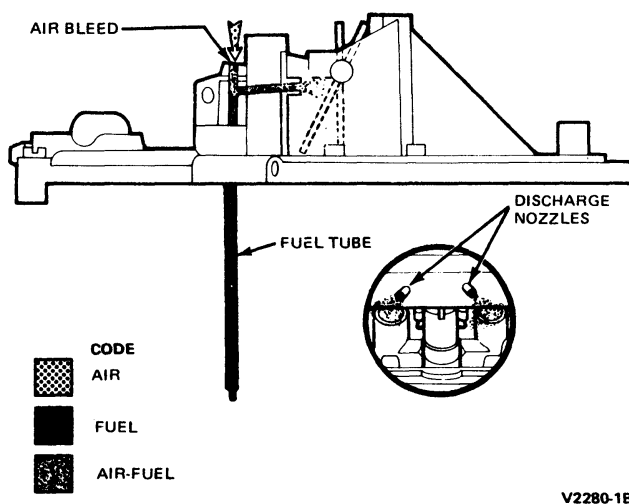


FIG. 12 High Speed Pullover System

ENRICHMENT SYSTEM

During periods of increased road loads or high speed operation, the air-fuel ratio must be increased for added power. The added fuel required during this period is supplied by the enrichment system shown in

Fig. 13. The enrichment system is controlled by the intake manifold vacuum. Manifold vacuum is transmitted from an opening in the base of the main body, through a passage in the main body and enrichment valve chamber to the enrichment valve diaphragm. On some applications (both single stage and dual stage power valves affected), manifold vacuum is transmitted through an external tap in the enrichment valve cover (Fig. 13). The manifold vacuum, acting on the enrichment valve at idle speed or normal road load conditions, is great enough to hold the enrichment valve diaphragm down, overcoming the tension of the spring on the valve stem, and holding the valve closed. When high power operation places a greater load on the engine, and manifold vacuum drops below a predetermined value, the spring opens the enrichment valve. Fuel from the fuel bowl flows through the enrichment valve and into passages leading to the main fuel well. Here the additional fuel is added to the fuel from the main fuel system, enriching the mixture. As engine power demands are reduced, manifold vacuum increases. The increased vacuum overcomes the tension of the valve stem spring and closes the enrichment valve.

In addition, some applications use a 2-stage power valve. The 2-stage valve works the same as the single stage valve except that the first stage has a restrictor inlet and as the engine load further increases after the first stage is opened the manifold vacuum drops below a second predetermined value and the second stage of the power valve opens. This allows additional fuel to be added to the main fuel system.

On carburetors equipped to compensate for high altitude, or lower atmospheric pressures, a bypass air intake system leans out the enrichment conditions that occur at higher altitudes due to lower air densities. The system consists of a main bypass circuit, a bypass choke, an aneroid and metering valve assembly (Fig. 14).

The aneroid operates on the principle of a bellows which reacts to pressure changes to open or close the metering valve. This provides additional air required at higher altitudes to maintain the correct fuel/air mixture.

During open throttle operation, air enters the bypass channel in the air horn and passes through the poppet type metering valve in the main body. From the metering valve, it is directed through a passage where it enters the main airstream below the venturi booster assembly and above the throttle plates.

For cold starting, the choke plate in the bypass intake restricts the air intake to allow the richer mixture for starting and cold engine operation. The bypass choke is connected to the main choke with a link between the choke plate shaft levers.

THROTTLE POSITIONERS

Various throttle positioners are used on the 2150-2V truck carburetors depending on vehicle applications. Solenoids can be used as an anti-dieseling device. When the solenoid is energized (ignition "on") it holds the throttle at curb idle. When the solenoid is de-energized (ignition "off"), it permits the throttle plate to close which lowers the idle speed for engine shut down to eliminate dieseling. Solenoids are also used on

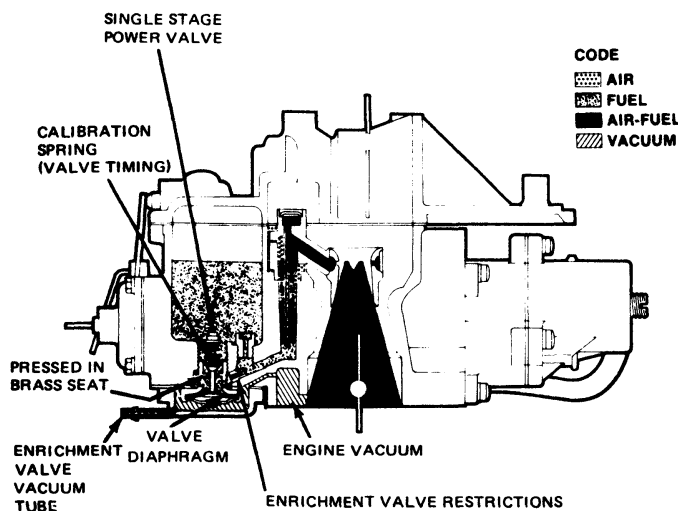


FIG. 13 Enrichment System

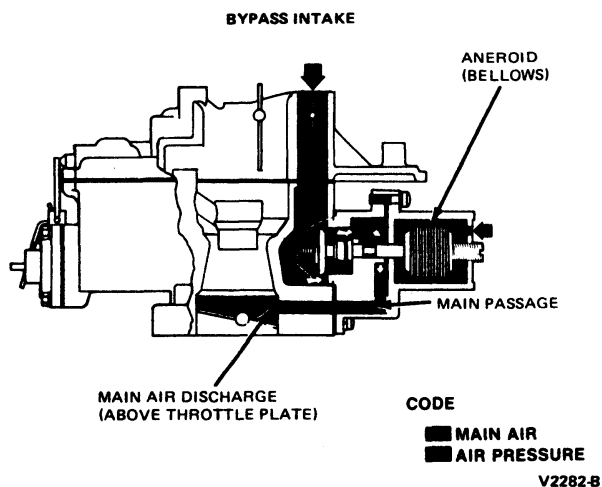


FIG. 14 Enrichment System—High Altitude Compensation

air conditioning applications to effect a higher idle speed when the air conditioning is operating (Fig. 17).

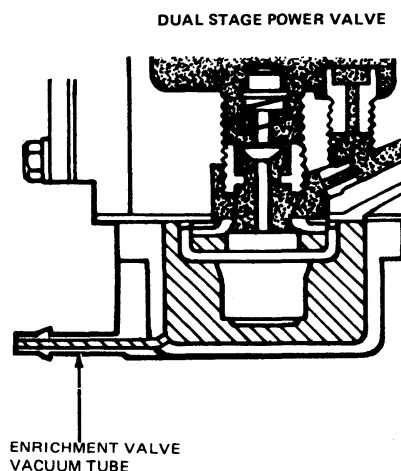
A **dashpot** permits the throttle plates to slowly return to idle during deceleration (Fig. 17).

A **vacuum** kicker is used to open the throttle on high vacuum decels to maintain a fuel-air mixture necessary for improved combustion (Fig. 17).

The **solenoid-diaphragm** (sol-a-vac) combines the function of the vacuum kicker with the solenoid (Fig. 17).

The **solenoid-dashpot** (through adjust type) combines the function of the dashpot with an anti-dieseling solenoid. The curb idle is set with the solenoid on and turning the through adjust screw. (Fig. 17).

The **solenoid dashpot** (bracket adjust type) is different in the "solenoid" function which is used for A/C RPM increase. The solenoid portion is factory set and no speed adjustment is done in the field. The curb idle is set with the solenoid off and turning the bracket adjust screw. The conventional curb idle screw is on the



V2281-D

main body of the carburetor but is not used for any adjustment. (Fig. 17).

TAMPER-RESISTANT FEATURES

Idle Mixture

Some applications will have two-piece metal plugs and caps in place of the plastic idle limiter caps on the idle mixture adjusting screws (Fig. 15). A special Tool (No. T80E-9516-A) or equivalent was designed to facilitate reinstalling the tamper-resistant cap on the plug. Follow the procedure in Part 29-02 and 50-29 for removing the idle mixture caps and reinstalling the caps using the special tool.

Choke Cap

Some applications will have riveted choke caps. The rivets are 1/8 inch long x 1/4 inch diameter head-Ford Part No. 388299. A special rivet gun nosepiece Tool No. D80P-53700-A has been designed to facilitate reinstalling the rivets. The nosepiece is designed to be used with rivet gun Tool No. D79P-53700-A. Follow the procedure in Part 29-02 and 50-29 for the removal and reinstallation of the choke cap rivets.

Choke Cap Removal

1. Remove carburetor assembly.
2. Check choke cap retaining ring rivets to determine if mandrel is well below the rivet head. If mandrel appears to be at or within the rivet head thickness, drive it down or out with a 1/16 in. diameter tip punch.
3. Use a 1/8 inch diameter or No. 30 drill (.128 in. diameter) for drilling the rivet heads. Drill into the rivet head until the rivet head comes loose from the rivet body. **CAUTION: EXCESSIVE PRESSURE ON THE DRILL BIT AT THIS POINT COULD CAUSE THE RIVET TO SPIN IN THE HOLE.**
4. After the rivet head is removed, drive the remaining portion of the rivet out of the hole with a 1/8 inch diameter punch. **NOTE: This procedure must be followed to retain the hole size.**
5. Repeat Steps 1 through 4 for the remaining rivets.

Choke Cap Installation

1. Install choke cap gasket with gasket holes matching casting holes.
2. Hold cap against gasket after bi-metal outer tang is inserted in slot of thermostat lever.
3. While holding cap in place set retaining clamp over choke cap and orient clamp to match holes in casting (holes are not equally spaced). Make sure retaining clamp is not upside down.
4. Place rivet in rivet gun and trigger lightly to retain rivet (rivet may slip off gun). Use "Marson Rivet Gun HP-2" Ford No. D79P-53700-A or equivalent with special nose piece Tool No. D80P-53700-A and Ford rivet Part No. 388299 (1/8 in. diameter x 1/2 in. long x 1/4 in. diameter head).
5. Rotate choke cap to specified setting. Hold cap at setting during the riveting operation (Fig. 20).
6. Press rivet fully into casting after passing through retaining clamp and "pop" rivet (mandrel breaks off).
7. Repeat this step for all remaining rivets.

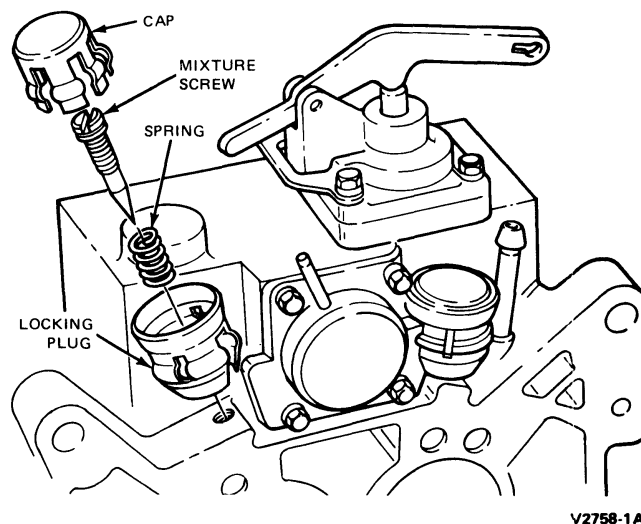


FIG. 15 Tamper-Resistant Metal Plug and Cap

DIAGNOSIS AND TESTING

Refer to Part 29-02 of this manual for all diagnosis and testing.

ADJUSTMENTS

Most carburetor adjustments are set at assembly, based on guidelines established for reduced engine emissions and acceptable driveability.

Refer to Parts 29-02 and 50-29 Pre-Delivery and Emissions Manual for the following adjustment procedures.

- Idle fuel mixture
- Idle CO
- Idle speeds
- Automatic choke

Choke cover setting and idle speed specifications are provided on the Engine Emission Decal on each vehicle. Other specifications can be found in the Truck Performance Specification Manual. Adjustment points for these items are shown in Figs. 15 through 22.

ACCELERATING PUMP STROKE ADJUSTMENT

The accelerating pump stroke has been factory set for a particular engine application and should not be re-adjusted. If the stroke has been changed from the specified hole re-set to specifications by following these procedures (Fig. 21).

1. To release the rod from the retaining clip, lift upward on the portion of the clip that snaps over the shaft and then disengage the rod.
2. Position the clip over the specified hole in the overtravel lever and insert the operating rod through the clip and the overtravel lever. Snap the end of the clip over the rod to secure.

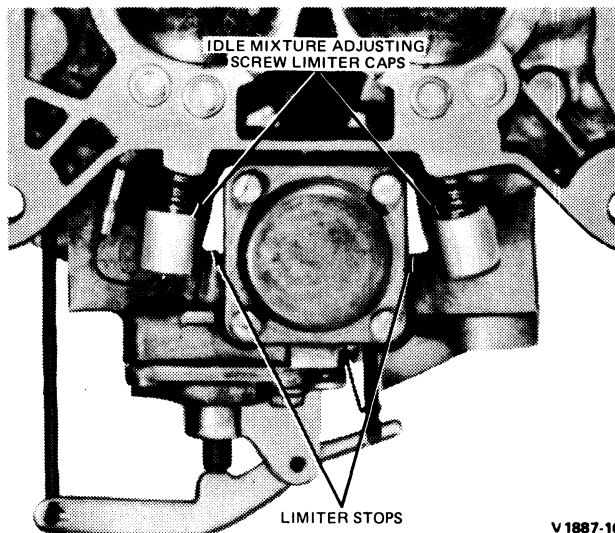


FIG. 16 Idle Fuel Mixture Adjusting Screw Limiters and Stops

EXTERNAL FUEL BOWL VENT VALVE (IF SO EQUIPPED)

1. Fully depress the vent valve into the valve bore with carburetor throttle at curb idle position (Fig. 22).
2. Measure the clearance between the flat on the vent rod and the fully seated valve.
3. If the clearance is not to specification, bend the vent rod at the point where it contacts the

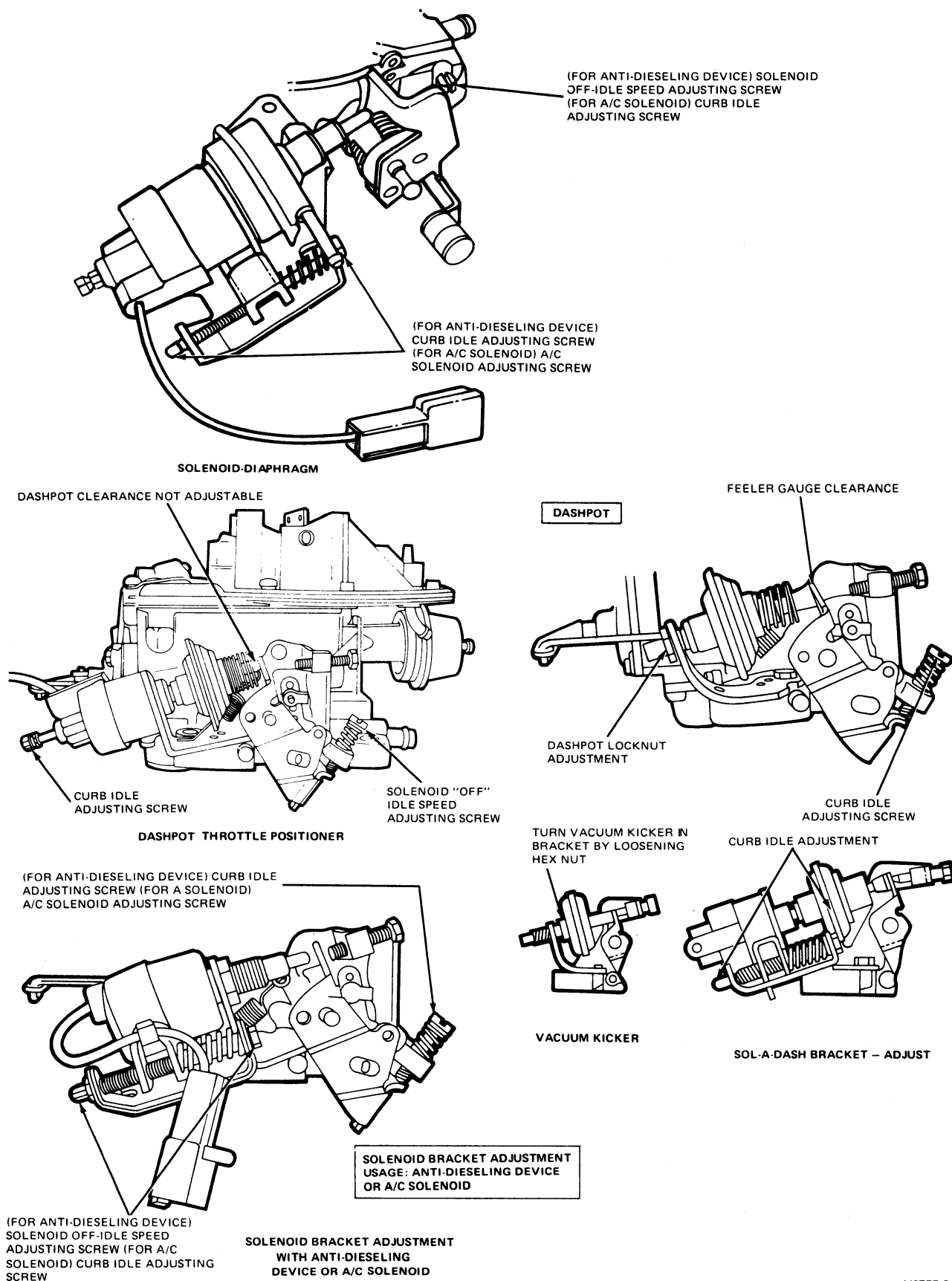


FIG. 17 Curb Idle Adjustment with Throttle Positioners

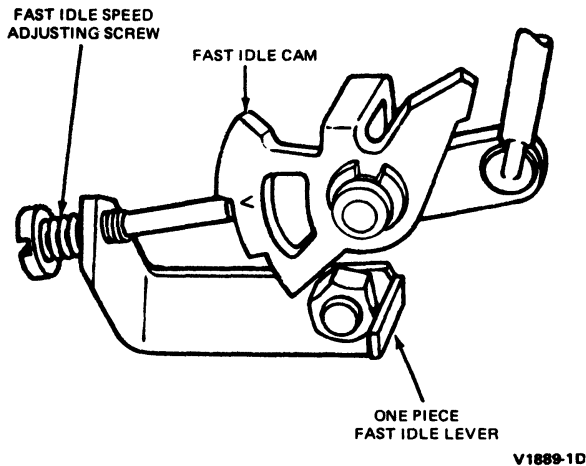


FIG. 18 Fast Idle Speed Adjustment—Automatic Choke Carburetor

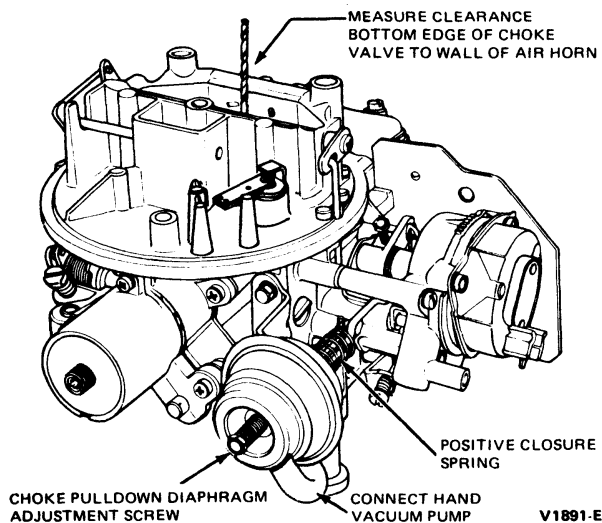


FIG. 19 Adjusting Choke Plate Pulldown

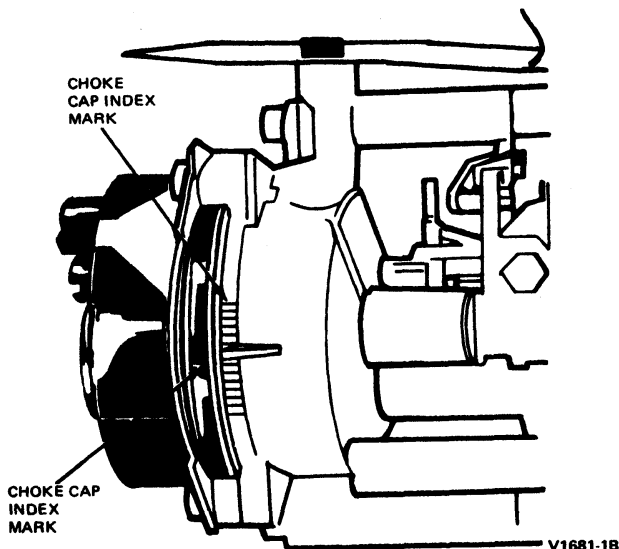


FIG. 20 Automatic Choke Thermostatic Spring Housing Adjustment

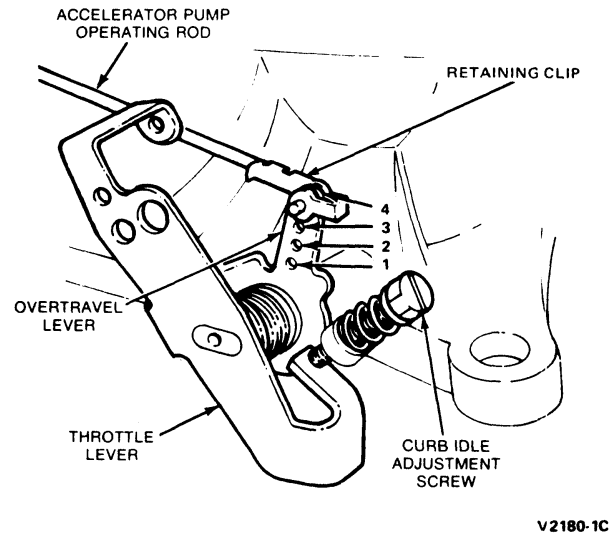


FIG. 21 Typical Accelerator Pump Stroke Adjustment

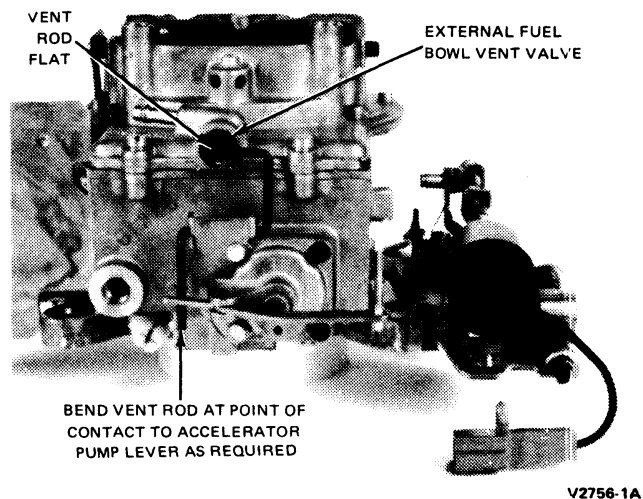


FIG. 22 External Fuel Bowl Vent Valve

accelerator pump lever until the specified clearance is obtained. When adjusting, make sure the throttle is in curb idle position.

FUEL LEVEL (FLOAT) ADJUSTMENT—DRY

The dry float adjustment is a preliminary fuel level adjustment only. The final adjustment (Fuel Level Float Adjustment—Wet) must be made after the carburetor is mounted on the engine.

With the air horn removed, the float raised and the fuel inlet needle seated, check the distance between the top surface of the main body (gasket removed) and the top surface of the float for conformance to specifications. Depress float tab to seat fuel inlet needle. **CAUTION: EXCESSIVE PRESSURE CAN DAMAGE THE VITON TIP ON THE NEEDLE.** Take the measurement near the center of the float at a point 3.2mm (1/8 inch) from the free end of the float.

If the cardboard float gauge is used, place the gauge in the corner of the enlarged end section

of the fuel bowl (Fig. 23). The gauge should touch the float near the end, but not on the end radius.



FIG. 23 Fuel Level (Float) Adjustment—Dry

If necessary, bend the tab on the float to bring the setting within the specified limits. This should provide the proper preliminary fuel level setting.

FUEL LEVEL (FLOAT) ADJUSTMENT—WET

1. Operate the engine to normalize engine temperatures, and place the vehicle on a flat surface as near level as possible. Stop the engine.
2. Remove the carburetor air cleaner assembly if not previously removed.
3. Remove the air horn attaching screws and the carburetor identification tag. Temporarily leave the air horn and gasket in position on the carburetor main body and start the engine. Let the engine idle for a few minutes, then remove the air horn and gasket to provide access to the float assembly.
4. While the engine is idling, use a standard depth scale to measure the vertical distance from the top machined surface of the carburetor main body to the level of the fuel in the fuel bowl (Fig. 24). The measurement must be made at least 6.4mm (1/4 inch) away from any vertical surface to assure an accurate reading, because the surface of the fuel is concave (higher at the edges than in the center). Refer to the specifications for the correct fuel level (wet) setting.

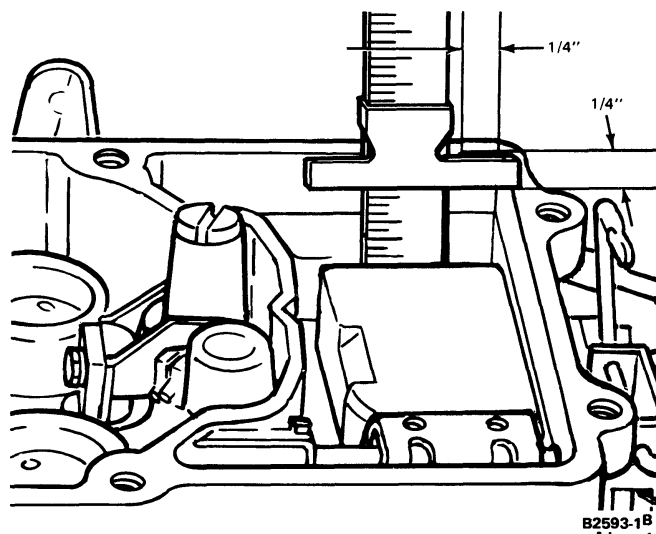


FIG. 24 Fuel Level (Float) Adjustment—Wet

5. If any adjustment is required, stop the engine to minimize the hazard of fire due to fuel spray when the float setting is distributed. To adjust the fuel level, bend the float tab (contacting the fuel inlet valve) upward in relation to the original position to raise the fuel level, and downward to lower it. Each time an adjustment is made to the float tab to alter the fuel level, the air horn must be re-installed and held in place with the two screws, the engine started and permitted to idle for a few minutes to stabilize the fuel level. Remove the screws and air horn and check the fuel level after each adjustment until the specified level is obtained.
6. Install a new air horn gasket, the air horn assembly, carburetor identification tag and the attaching screws. Be sure the plastic dust seal on the choke operating rod is positioned correctly and does not cause the rod to bind. Tighten the screws.
7. Check the idle fuel mixture, idle speed adjustments and the carburetor throttle positioner adjustment (if so equipped). Adjust the carburetor as required following specifications on the Vehicle Emission Control Information Decal and procedures in Parts 50-29 of the Pre-Delivery, Maintenance and Lubrication manual and Part 29-02 in this manual.
8. Install the air cleaner.

REMOVAL AND INSTALLATION

CARBURETOR ASSEMBLY

Flooding, stumble on acceleration and other performance complaints are in many instances, caused by the presence of dirt, water, or other foreign matter in the carburetor. To aid in diagnosing the cause of complaint, the carburetor should be carefully removed from the engine without removing the fuel from the bowl. The contents of the bowl may then be examined for contamination as the carburetor is disassembled.

On vehicles equipped with automatic transmission, the transmission kickdown lever must be adjusted whenever the carburetor assembly is removed. (Refer to Part 24-60 for kickdown lever adjustment.)

Removal

1. Remove the air cleaner.
2. Remove the throttle cable from the throttle lever. Disconnect all vacuum lines, emission hoses, the fuel line and the choke heat tube at the carburetor.

3. Remove the carburetor retaining nuts; then remove the carburetor. Remove the carburetor mounting gasket, spacer (if equipped) and lower gasket from the intake manifold.

Installation

1. Clean the gasket mounting surfaces of the spacer and carburetor. Place the spacer between two new gaskets and position the spacer and gaskets on the intake manifold. Position the carburetor on the spacer and gasket. Position and connect the choke heat tube. Take care to avoid damage to the tube nut. Secure the carburetor with the attaching nuts. To prevent leakage, distortion or damage to the carburetor body flange, snug the nuts; then, alternately tighten each nut in a criss-cross pattern to the specified torque listed at the back of the applicable engine Part In Group 21.
2. Connect the fuel line, throttle cable, and all emission lines and vacuum lines removed. Observe color coded vacuum line connections on carburetor.
3. Adjust the engine idle speeds, fuel mixture, and check and adjust the accelerator pump stroke if necessary. (Make sure the rod is set in the specified hole) (Fig. 21).

AIR HORN TO MAIN BODY GASKET

AUTOMATIC CHOKE CARBURETOR (FIGS. 32 AND 33)

Removal

1. Remove the air cleaner.
2. Disconnect the automatic choke clean air tube at the carburetor.
3. Remove the automatic choke plate operating rod to choke lever retainer.
4. Remove the air horn attaching screws and lock washers, and the carburetor identification tag. Remove the air horn gasket.

Installation

1. Install a new air horn to main body gasket. **Make sure all holes in the new gasket have been properly punched and that no foreign material has adhered to the gasket.**
2. Position the air horn on the main body and gasket so that the choke plate operating rod fits into the opening in the choke housing lever. Install the choke plate rod retainer. Be sure the plastic dust shield on the choke operating rod is properly positioned and does not cause the rod to bind.
3. Install the air horn attaching screws and lockwashers and the identification tag.
4. Connect the automatic choke clean air tube to the carburetor.
5. Adjust the idle fuel mixture and idle speed as outlined in Part 50-29 of the Pre-Delivery, Maintenance and Lubrication manual and specified on the Vehicle Emission Control Information Decal.
6. Install the carburetor air cleaner assembly.

FLOAT, NEEDLE VALVE AND SEAT, INLET SCREEN OR MAIN JETS

Removal

1. Remove the carburetor air horn to main body gasket by following the procedure under Air Horn to Main Body Gasket Replacement.
2. With the use of a screwdriver, pry the float shaft retainer from the fuel inlet seat (Fig. 25). Remove the float, float shaft retainer and fuel inlet needle assembly (Fig. 26).

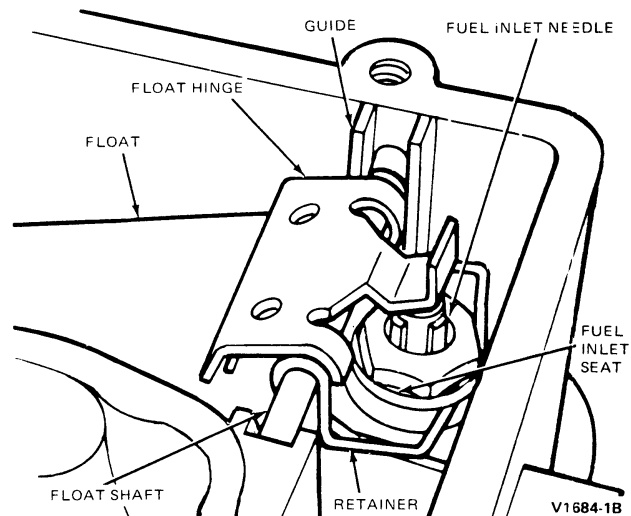


FIG. 25 Float Assembly

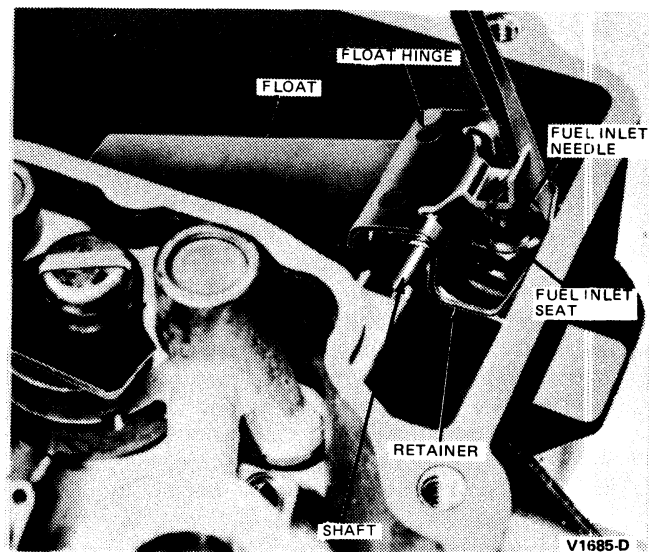


FIG. 26 Removing or Installing Float Shaft Retainer

3. If required, remove the fuel inlet needle seat, filter screen, baffle and main jets with a jet wrench. Be sure the correct (specified) jets are installed (Figs. 32 and 33).

Installation

1. If required, install the fuel inlet filter in the inlet valve seat bore. Install the valve seat, baffle and gasket. Install the fuel inlet needle valve.

- Slide the float shaft into the float lever. Position the float shaft retainer on the float shaft.
- Insert the float assembly into the fuel bowl and hook the float lever tab under the fuel inlet needle clip. Insert the float shaft into the guides at the sides of the fuel bowl.
- With the use of the screwdriver, position the float shaft retainer on the groove of the fuel inlet needle seat.
- Perform a dry float fuel level adjustment on the float.
- Perform the wet fuel level adjustment procedures.
- Install the carburetor air horn and gasket and related parts. Refer to Air Horn to Main Body Gasket Replacement.
- Adjust the idle fuel mixture and engine idle speed to specifications on the Vehicle Emission Control Decal and in Part 50-29 of the Pre-Delivery, Maintenance and Lubrication manual.

ACCELERATOR PUMP DIAPHRAGM AND/OR ELASTOMER VALVE

Removal

- Remove the carburetor air horn to main body gasket following the procedure under Air Horn to Main Body Gasket Replacement.
- Remove the accelerator pump operating rod retainer. To release the rod from the retaining clip, lift upward on the portion of the clip that snaps over the shaft and then disengage the rod. Remove the rod. Remove the vent valve actuating lever.

Note: The two retention screws for the left side are longer. Remove the accelerator pump cover, diaphragm assembly and spring (Fig. 27, 32 and 33).

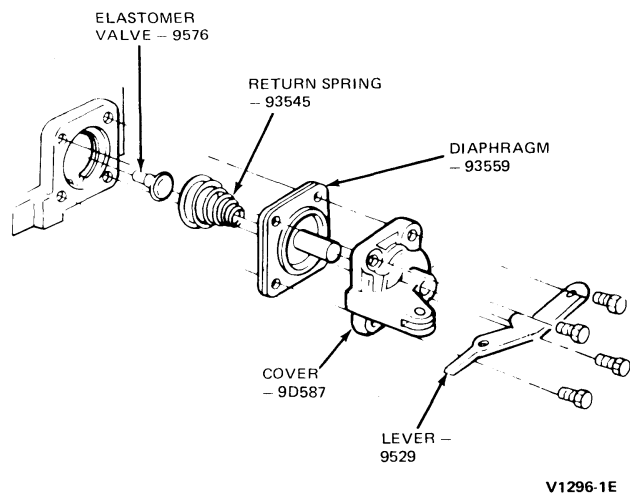


FIG. 27 Accelerating Pump Assembly

- If inspection shows necessity to remove the Elastomer valve, grasp it firmly and pull it out. If the Elastomer valve tip broke off during removal, be sure to remove the tip from the fuel bowl. An Elastomer valve must be replaced whenever it is removed from the main body.

Installation

- If the Elastomer valve was removed, lubricate the tip of a new valve and insert the tip into the accelerator pump cavity. Using needle-nosed pliers, reach into the fuel bowl and grasp the valve tip. Pull the valve in until it seats, and cut off the tip forward of the retainer shoulder. Remove the tip from the bowl.
- Position the new accelerator pump diaphragm assembly to the cover and place the cover and diaphragm assembly in position on the return spring and main body. **The large end of the spring must face the Elastomer valve.** Install the two right hand (shorter) cover screws finger tight. Position the vent valve actuating lever and install it with two (longer) cover screws finger tight. Push the accelerator pump plunger the full length of travel and tighten the cover screws. **NOTE: On carburetors not equipped with mechanical vent, the cover screws are all the same length.**
- Position the accelerator pump operating rod in the hole in the pump operating arm.
- Adjust the accelerator pump stroke to specification by installing the accelerator pump rod in the proper hole in the overtravel lever. Position the rod retainer over the proper hole and insert the end of the rod through the hole in the retainer. Snap the end of the retainer over the rod.
- Install the carburetor air horn and gasket.

CHOKE PULLDOWN DIAPHRAGM ASSEMBLY

Removal

- Remove the air cleaner.

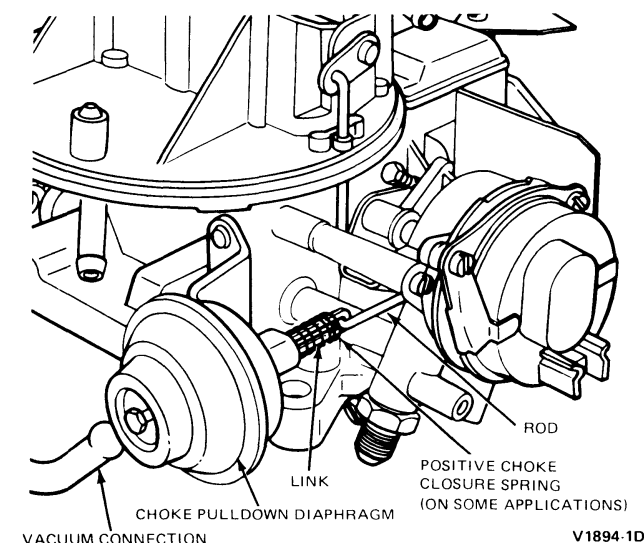


FIG. 28 Choke Pulldown Diaphragm Assembly

- Remove the two attaching screws from the bracket, disconnect the vacuum supply tube and remove the pulldown diaphragm.
- Rotate diaphragm assembly to disengage choke pulldown rod (Fig. 28). For modulated systems, remove (and retain) E-chip from choke pulldown rod.

Installation

1. Engage rod in diaphragm assembly link. Rotate assembly to align mounting bracket with main body casting. For modulated systems, attach rod and install E-clip. Install two attaching screws.

2. Connect the vacuum supply tube to the correct vacuum base tube connection.
3. Perform the automatic choke pulldown and fast idle cam adjustments as described in Part 50-29.
4. Install the air cleaner assembly.

DISASSEMBLY AND ASSEMBLY

DISASSEMBLY

To facilitate working on the carburetor, and to prevent damage to the throttle plates, install carburetor legs on the base. If legs are unavailable, install four bolts (about 57mm or 2 1/4 inches long of the correct diameter) and eight nuts on the carburetor base.

Use a separate container for the component parts of the various assemblies to facilitate cleaning, inspection and assembly.

The following is a step-by-step sequence of operations for completely overhauling the carburetor (Figs. 32 and 33). However certain components of the carburetor may be serviced without a complete disassembly of the entire unit. For a complete carburetor overhaul, follow all of the steps. To partially overhaul a carburetor or to install a new gasket kit, follow only the applicable steps.

On vehicles equipped with automatic transmissions, the transmission kickdown lever must be adjusted whenever the carburetor assembly is removed. (Refer to Part 24-60 for kickdown lever adjustment.)

Refer to Part 24-01 for cleaning and inspection procedures.

AIR HORN

1. Remove the air cleaner anchor screw.
2. Remove the automatic choke control rod retainer.
3. Remove the air horn attaching screws, lockwashers and the carburetor identification tag. Remove the air horn and air horn gasket.
4. Remove the choke control rod by loosening the screw that secures the choke shaft lever to the choke shaft, (automatic choke only). Remove the rod from the air horn. Remove the plastic dust shield from the choke rod.
5. If it is necessary to remove the choke plate, remove the staking marks on the choke plate attaching screws and remove the screws. Remove the choke plate by sliding it out of the shaft from the top of the air horn. Remove any burrs around screw holes prior to removing chokeshaft. If equipped with altitude compensation, rotate main choke shaft and disconnect connecting link. Slide the choke shaft out of the air horn.

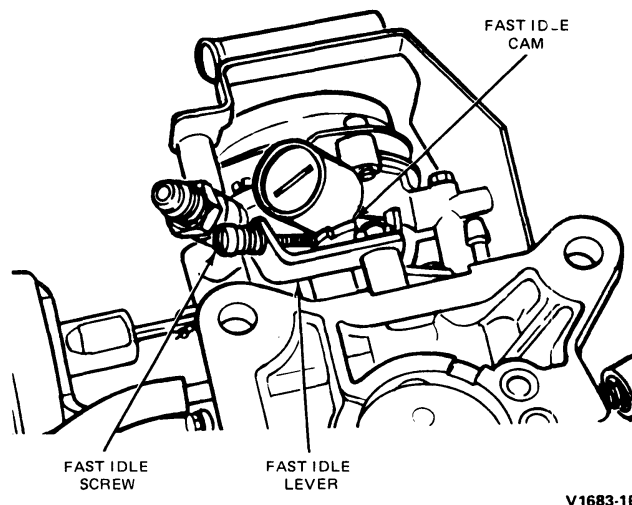
On altitude compensating carburetors the bypass choke plate is removed the same as the main choke plate. To remove the choke plate shafts, remove the link retainer and the link, then slide the shafts out of the air horn body.

CHOKE PULLDOWN DIAPHRAGM ASSEMBLY

Follow procedures given under Removal and Installation.

AUTOMATIC CHOKE

1. Remove the fast idle cam retainer (Fig. 29).



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FIG. 29 Fast Idle Cam and Fast Idle Lever

2. Remove the thermostatic choke spring housing retaining screws and remove the clamp, housing and gasket.
3. Remove the choke housing assembly retaining screws. If the air horn was not previously removed, remove the choke control rod retainer. Remove the choke housing assembly, gasket and the fast idle cam and rod from the fast idle cam hub.
4. Remove the choke lever retaining screw and washer. Disconnect the choke control rod from the choke lever. Remove the choke lever and fast idle cam lever from the choke housing.

MAIN BODY

1. Using screwdriver, pry the float shaft retainer from the fuel inlet seat (Fig. 25). Remove the float, float shaft retainer and fuel inlet needle assembly. Remove the retainer, float shaft and float damper spring (if so equipped) from the float lever (Fig. 26)
2. Remove the fuel inlet needle, seat, filter screen, and the main jets with a jet wrench.
3. Remove the booster venturi screw (accelerator pump discharge), booster venturi and metering rod assembly and gasket. Invert the main body and let the accelerator pump discharge weight and ball fall into the hand. To disassemble the lift rod from the booster remove the lift spring retaining clip and spring. Then separate the lift rod assembly from the

booster. Do not disassemble the metering rod hanger from the lift rod.

4. Remove the accelerator pump operating rod from the overtravel lever and the retainer. To release the operating rod from the overtravel lever retainer press upward on that part of the retainer that snaps over the rod. Disengage the rod from the retainer and from the overtravel lever. Remove the rod and retainer.
5. Remove the accelerator pump cover attaching screws. Remove the vent valve actuating lever, if equipped. Note: The two retention screws for the left side are longer when a mechanical vent valve is used. Remove the accelerator pump cover, diaphragm assembly and spring (Fig. 27).
6. If it is necessary to remove the Elastomer valve, grasp it firmly and pull it out. If the Elastomer valve tip broke off during removal, be sure to remove the tip from the fuel bowl. **An Elastomer valve must be replaced whenever it has been removed from the carburetor.**
7. Invert the main body and remove the enrichment valve cover and the gasket. Remove the enrichment valve with a box wrench or socket wrench (Fig. 30). Remove the enrichment valve gasket. Discard the gasket.

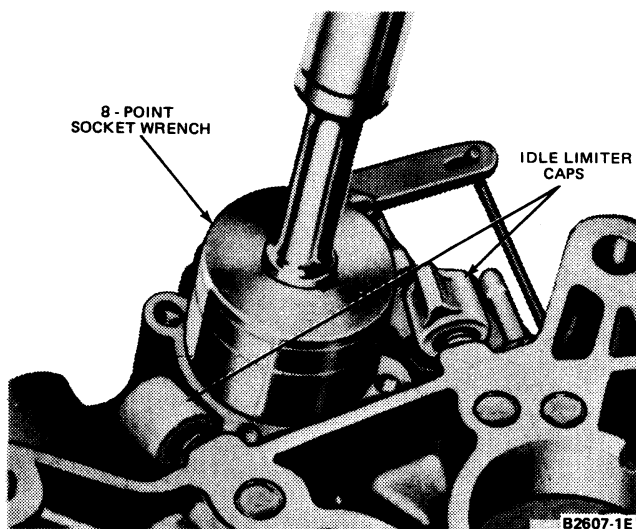


FIG. 30 Removing or Installing Enrichment Valve

8. Remove the idle fuel mixture adjusting screws (needles) and the springs. Remove the limiters from the adjusting screws.
9. If necessary, remove the nut and washer securing the fast idle adjusting lever assembly to the throttle shaft, and remove the lever assembly. If necessary, remove the idle screw and the retainer from the fast idle adjusting lever.
10. Remove the throttle positioner (if so equipped).
11. If it is necessary to remove the throttle plates, lightly scribe the throttle plates along the throttle shaft and mark each plate and its corresponding bore with a number or letter for proper installation (Fig. 31). File off the staked portion of the throttle plate screws prior to their removal.

12. Remove any burrs caused by screw removal to prevent scoring the throttle shaft bores as the throttle shaft is withdrawn. Catch the mechanical high speed bleed actuator located on the throttle shaft between the throttle plates.
13. On altitude compensating carburetors remove the attaching four screws and remove the aneroid and valve assembly and the gasket. If necessary remove the three aneroid-to-valve screws and separate the aneroid, gasket and valve.

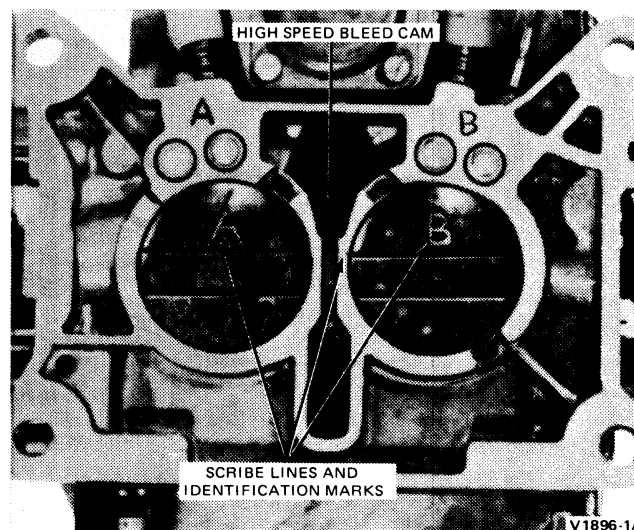


FIG. 31 Scribing Throttle Plates

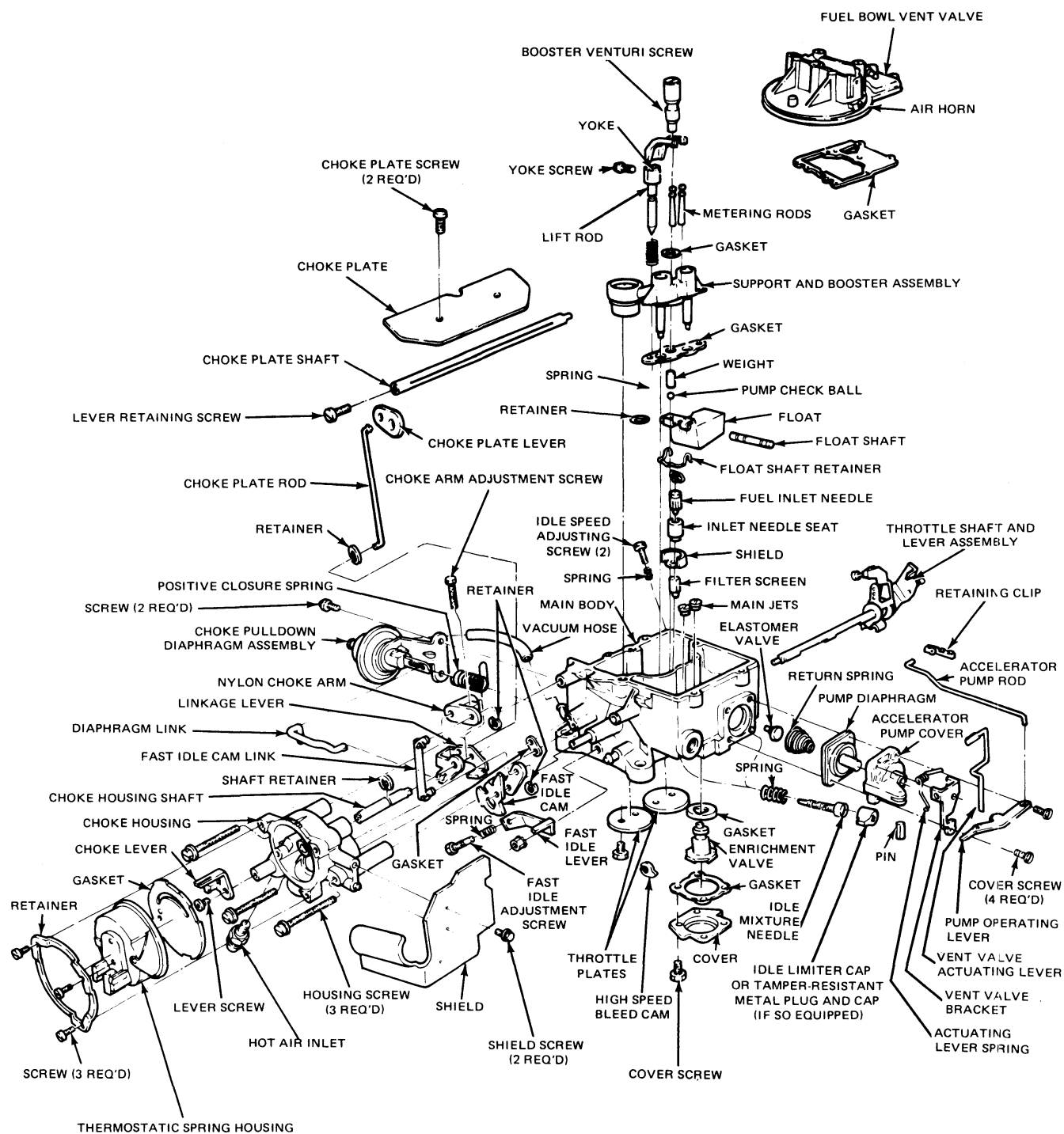
Clean and inspect the carburetor component parts according to procedures outlined in Part 24-01 of this Manual.

ASSEMBLY

Make sure all holes in new gaskets have been properly punched, and that no foreign material has adhered to the gaskets. Make sure the accelerating pump diaphragm is not turned or cut. The Model 2150 2-V carburetor is shown disassembled in Figs. 22, and 23.

MAIN BODY

1. Slide the throttle shaft assembly into the main body until it begins to enter the high speed bleed cam slot in the body.
2. Hold the cam by the edge of the point, in the slot and rotate the throttle shaft until the shaft passes through the cam. Rotate the shaft clockwise until the throttle lever clears the boss for the throttle solenoid positioners TSP "Off" idle speed screw. Continue inserting the shaft into proper position, rotating as necessary to properly position cam.
3. Refer to the lines scribed on the throttle plates (Fig. 31) and install the throttle plates in their proper location with the screws snug, but not tight. Always use new screws when installing throttle plates.
4. Close the throttle plates. Invert the main body, and hold it up to the light. Little or no light should show between the throttle plates and the throttle bores. Tap the plates lightly with a screwdriver handle to



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FIG. 32 Model 2150 2-V—Without Compensator

- seat them. Hold the throttle plates closed and tighten and stake the attaching screws. Stake hardened screws by crimping exposed threads with diagonal cutters.
5. If the aneroid was separated from the metering valve assembly, position a new gasket and the aneroid to the valve and install the attaching screws. Using a new gasket position the aneroid valve assembly to the carburetor and install the four retaining screws, (Fig. 33).
 6. Install the anti-stall dashpot, solenoid, or solenoid-dashpot, solenoid-diaphragm, or vacuum kicker if equipped.
 7. Place the fast idle adjusting lever assembly on the throttle shaft and install the retaining washer and nut (Fig. 32). If necessary, install the fast idle screw (and spring) on the fast idle.
 8. Invert the main body. Install the enrichment valve and new gasket with a wrench (Fig. 30). Tighten the valve securely.
 9. Install the idle mixture adjusting screws (needles) and springs (Fig 32). Turn the needles in gently with the fingers until they just touch the seat, then back them off 1 1/2 turns for a preliminary idle fuel mixture adjustment. **Do not install the idle mixture limiters at this time. Install the enrichment valve cover and new gasket. The cover must be installed with the limiter stops on the cover in position to provide a positive stop for the tabs on the idle mixture adjusting screws limiters.**
 10. If the Elastomer valve was removed, lubricate the tip of a new Elastomer valve and insert the tip into the accelerator pump cavity center hole. Using a pair of needle nosed pliers, reach into the fuel bowl and grasp the valve tip. Pull the valve in until it seats in the pump cavity wall and cut off the tip forward of the retaining shoulder. Remove the tip from the bowl.
 11. Install the accelerating pump diaphragm return spring on the boss in the chamber (Fig. 27). Insert the diaphragm assembly in the cover and place the cover and diaphragm assembly into position on the main body. Install the right hand (shorter) cover screws finger tight.
 12. Install the mechanical vent system by positioning the vent valve actuating lever and install it with the two (longer) cover screws finger tight, when equipped. Push the accelerator pump plunger the full length of the travel and tighten the cover screws.
 13. Insert the accelerator pump operating rod into the hole in the accelerating pump actuating lever. Position the accelerator pump operating rod retainer over the specified hole in the over-travel lever. Insert the operating rod through the retainer and the hole in the overtravel lever and snap the retainer down over the rod.
 14. Position the booster assembly gasket and booster venturi. Drop the accelerator pump discharge ball and weight into the passage in the main body. Install the pump discharge screw and gasket. Tighten the screw to specification.
 15. Install the main jets and the fuel inlet seat, filter screen, baffle and new gasket. **Be sure the correct jets are installed.**
 16. Install the fuel inlet needle assembly in the fuel inlet seat.
 17. Slide the float shaft into the float lever (Fig. 25). Position the float shaft retainer on the float shaft.
 18. Insert the float assembly into the fuel bowl and hook the float lever tab under the fuel inlet needle assembly. Place the float damper spring (if so equipped) on the left side of the float shaft (Figs. 25 and 32) and insert the float shaft into its guides at the sides of the fuel bowl.
 19. With a screwdriver, position the float shaft retainer in the groove on the fuel inlet needle seat (Fig. 25). Check the float setting. Make certain float does not interfere with elastomer valve.
- ### AUTOMATIC CHOKE
1. Position fast idle cam lever on thermostatic choke shaft and lever assembly. Bottom of fast idle cam lever adjusting screw must rest against tang on choke lever.
 2. Insert the choke lever into the rear of the choke housing. Position the choke lever so that the hole in the lever is to the left side of the choke housing.
 3. Install the fast idle cam rod on the fast idle cam lever. Place the fast idle cam on the fast idle cam rod and install the retainer. Place the choke housing vacuum pick-up port to main body gasket on the choke housing flange.
 4. Position the choke housing on the main body and at the same time, install the fast idle cam on the hub on the main body. Position the gasket, and install the choke housing attaching screws. Install the fast idle cam retainer. Install the thermostatic spring housing.
- ### CHOKE PULLDOWN DIAPHRAGM ASSEMBLY
- Refer to procedure under Removal and Installation.
- ### AIR HORN
- Refer to Figs. 32 and 33 for the correct location of the parts.
1. If the choke plate shaft was removed, position the shaft in the air horn, then install the choke plate rod and lever on the end of the choke shaft.

On altitude compensating carburetors, install the link to the choke plate shaft levers and install the link retainer, (Fig. 33).
 2. If the choke plate was removed, insert the choke plate into the choke plate shaft. Install the choke plate screws snug, but not tight. Check for proper plate fit, binding in the air horn and free rotation of the shaft by moving the plate from the closed position to the open position. If necessary, remove the choke plate and grind or file the plate edge where it is binding or scraping on the air horn wall. If the choke plate and shaft moves freely, tighten the choke plate screws while holding the choke in the fully closed position. Stake choke plate screws by crimping exposed threads with diagonal cut.

3. Position the main body gasket and the choke rod plastic seal over the choke rod. Position the air horn on the main body and gasket so that the choke plate rod fits through the seal and the opening in the main body.
4. Insert the end of the choke plate rod into the automatic choke lever. Install the air horn attaching screws and the carburetor identification tag. Tighten the attaching screws. Install the choke plate rod retainer.

Install the air cleaner anchor screw. Tighten the air cleaner anchor screw to the specified torque. Perform all automatic choke adjustments and other carburetor functions as required to meet specifications.

See Volume 50-29 or Part 29-02 of this Volume, for adjustments not covered in this Part.

SPECIFICATIONS

Adjustment procedures and service instructions for this carburetor are contained in Part 29-02 of this manual and in Part 59-29 of the Pre-Delivery, Maintenance and Lubrication Manual. Specifications are located in the Truck Performance Specifications Manual.

A typical Vehicle Emission Control Information Decal is shown below (Fig. 34). This decal is located on the engine and lists many of the specifications required for engine timing, idle, fuel mixture, etc.

FORD MOTOR COMPANY VEHICLE EMISSION CONTROL INFORMATION				EVAPORATIVE FAMILY IS	VACUUM HOSE ROUTING
ENGINE FAMILY		TRANS		SPARK PLUG GAP	CATALYST BYPASS VALVE VACUUM HOSE AND CONNECT A VACUUM HOSE FROM MANIFOLD VACUUM TO THE BYPASS VALVE (AIR BPV) ADJUST IGNITION TIMING AND TIMING RPM TO SPEC WITH VACUUM HOSE(S) DISCONNECTED AND PLUGGED AT THE DISTRIBUTOR IF EQUIPPED WITH A THROTTLE SOLENOID POSITIONER DASHPOT DISCONNECT SOLENOID WIRE AND COLLAPSE THE DASHPOT SET RPM USING CARBURETOR SET SCREW FAST IDLE ADJUST RPM TO SPEC WITH TRANS IN NEUTRAL (M/T) OR PARK (A/T) FAST IDLE CAM IN SPECIFIED POSITION D/P EGR VALVE VACUUM HOSE AT A D/P PURGE VALVE VACUUM HOSE AT B CURB IDLE ADJUST RPM TO SPEC WITH TRANS IN SPECIFIED MODE AND ALL VACUUM HOSES CONNECTED EXCEPT BYPASS VALVE THROTTLE SOLENOID POSITIONER ENERGIZED AND DASHPOT COLLAPSED IF SO EQUIPPED TSP OFF ADJUST RPM TO SPEC WITH THROTTLE SOLENOID POSITIONER WIRE DISCONNECTED AND THE DASHPOT COLLAPSED IF SO EQUIPPED IDLE MIXTURE IS PRESET AT FACTORY NOT ADJUSTED DURING SCHEDULED MAINTENANCE COMPLIANCE DEMONSTRATED BELOW 4000 FT
ENGINE DISPLACEMENT		TRANSMISSION GEAR			
SHIFT SCHED		NEUTRAL DRIVE			
IGNITION TIMING					
MAX TIMING RPM					
CHOKE SETTING					
FAST IDLE RPM	HIGH CAM				
	KICK DOWN				
CURB IDLE RPM	A/C				
	NON A/C				
TSP OFF RPM	A/C				
	NON A/C				
SET PARKING BRAKE AND BLOCK WHEELS DISCONNECT AUTOMATIC BRAKE RELEASE AND SENSOR CONNECTOR FROM DUAL MODE IGNITION MODULE IF SO EQUIPPED MAKE ALL ADJUSTMENTS WITH ENGINE AT NORMAL OPERATING TEMPERATURE A/C AND HEADLIGHTS OFF AND AIR CLEANER IN POSITION WHEN CHECKING ALL ENGINE SPEEDS DISCONNECT AND PLUG ID P THERMATOR AIR					
THIS VEHICLE CONFORMS TO U.S.E.P.A. REGULATIONS APPLICABLE TO 1980 MODEL YEAR NEW MOTOR VEHICLES					

CHOKE SETTING SPECIFICATION

FAST IDLE RPM SPECIFICATION

CURB IDLE RPM SPECIFICATION

THROTTLE SOLENOID POSITIONER OFF RPM SPECIFICATION (IF SO EQUIPPED)

ADJUSTMENT PROCEDURE NOTES

V2733-2A

FIG. 34 Typical Vehicle Emission Control Information Decal

SPECIAL TOOLS

Description	Tool Number (or Equivalent)
Tamper-Resistant Idle Mixture Cap Installation Tool	T80E-9516-A
Hand Rivet Gun	D79P-53700-A
Rivet Gun Nosepiece for Riveted Choke Cap	D80P-53700-A

V2757-1A

Model 4180 EG 4-V Carburetor

PART 24-28

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Decel Throttle Modulator	24-28-5	Metering Block	24-28-11
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DESCRIPTION

The Holley 4180 C used on the 460 4-V (7.5L) engine (Fig. 1) is a downdraft, two-stage carburetor. It can be considered as two dual carburetors; one supplying a fuel-air mixture throughout the entire range of engine operation (primary stage), and the other functioning only when a greater quantity of fuel-air mixture is required (secondary stage).

The primary stage (front section) of the carburetor contains a fuel bowl, metering block (Figs. 2 and 3), and an accelerating pump assembly. The primary barrels each contain a primary and booster venturi, main fuel discharge nozzle, throttle plate, and idle fuel passage. The model 4180-C uses a hot-air operated automatic choke system. GVW have hot air operated choke.

The model 4180-C 4-V carburetor incorporates a "Modulated Power Valve" System. This system insures power valve operation (opening) during heavy acceleration at times when manifold vacuum may increase beyond the point where the power valve would begin to close. This is accomplished by BLEEDING OFF any vacuum build up, when throttle opening angle is 50 degrees or greater. As the throttle is opened, a hole drilled through the throttle shaft aligns, with a channel

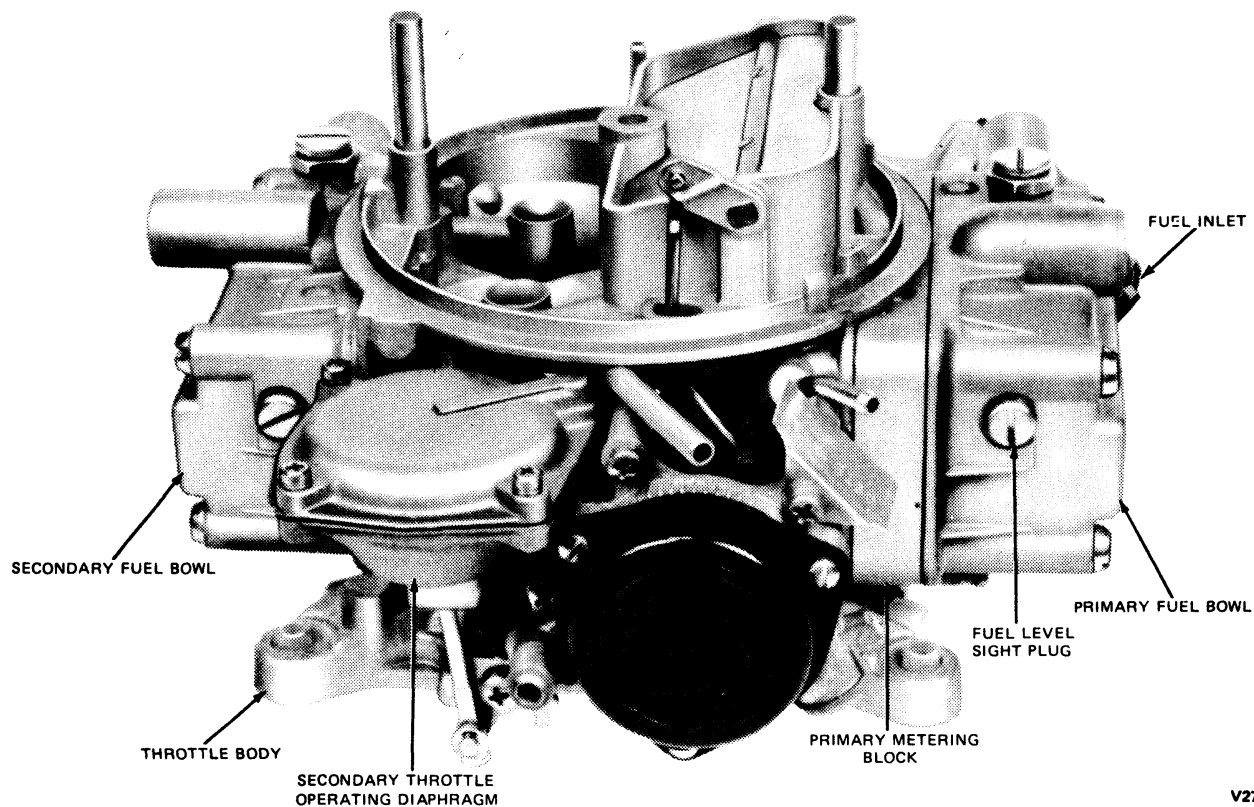
in the main body, completing a passage between the power valve vacuum channel and atmospheric pressure in the air horn area. Thus, vacuum is not permitted to build up at the greater throttle angles, and the power valve remains open.

The secondary stage, (rear section) of the carburetor contains a fuel bowl, metering body, and secondary throttle operating diaphragm assembly. Each secondary barrel contains a primary and booster venturi, idle fuel passages, main secondary fuel discharge nozzle, throttle plate, and a transfer system fuel passage.

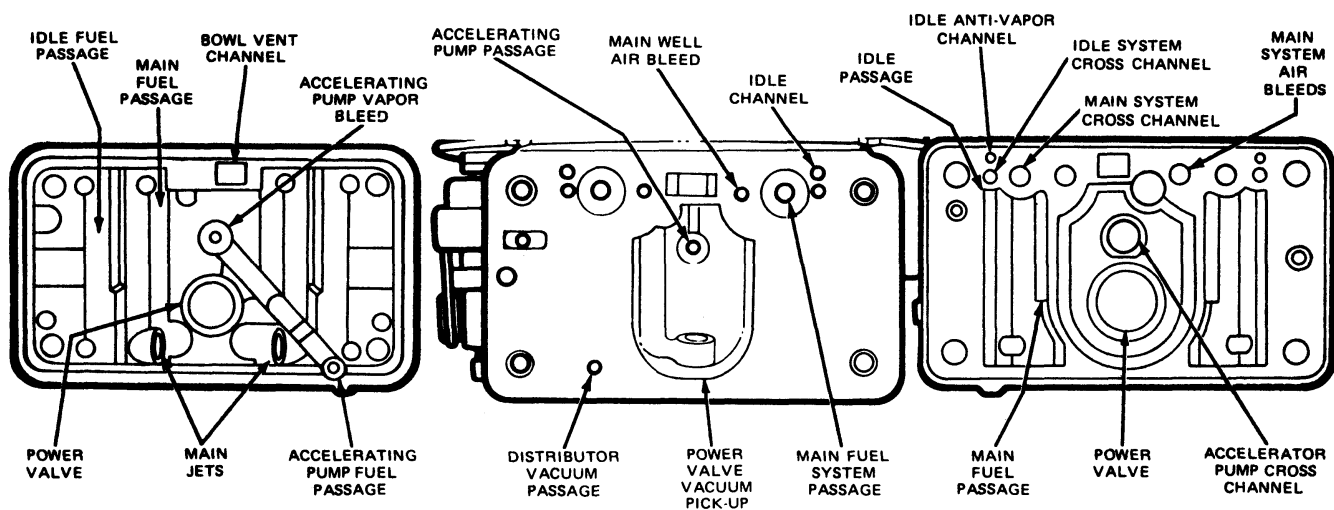
A fuel inlet system for both the primary and the secondary stages of the carburetor provides the fuel metering systems with a constant supply of fuel.

Vehicles over 8500 lbs G.V.W. use a decel throttle modulator which keeps the throttle plates from closing on deceleration for improved emission control.

No fuel balance tube is used on the model 4180-C 4-V Carburetor.



V2743-2A

FIG. 1 Holley 4180-C 4-V—Right Front View

V2744-2A

FIG. 2 Fuel Passages Identification

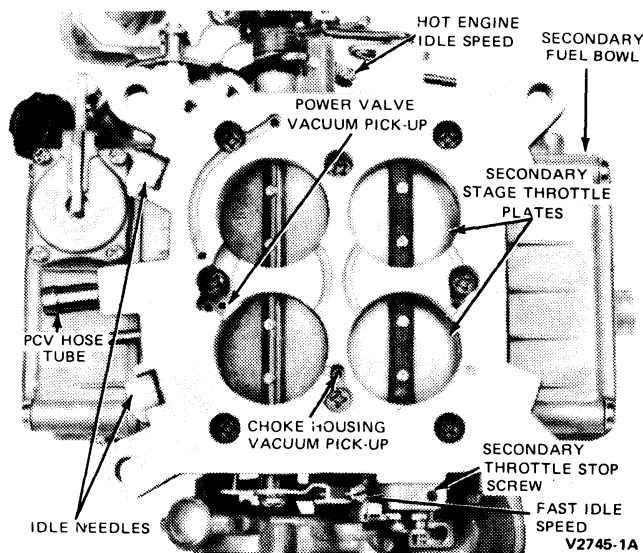


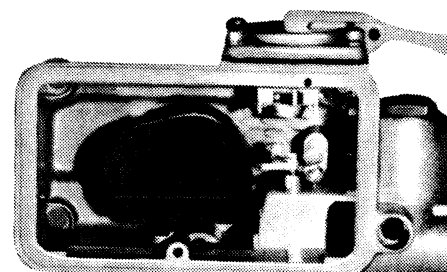
FIG. 3 4180-C - 4V Bottom View—Over 8500 lb GVW 49 States

ADJUSTMENTS

Most carburetor adjustments are set at assembly, based on guidelines established for reduced engine emission and acceptable driveability. For adjustment procedures for: Choke, Idle Speeds, Idle Fuel Mixture, Choke Pulldown, and Fast Idle Cam adjustments Idle CO, you must refer to Part 50-29 of Volume 5. Refer to the Vehicle Emission Control Information decal on the engine and to the Truck Performance Specification manual for specifications. Adjustment points are shown in Figs. 4 through 10.

FAST IDLE SPEED ADJUSTMENT

Refer to Fig. 3 for location of adjusting screw. Turn the adjusting screw as required to obtain the specified fast idle speed setting.



TURN ADJUSTING NUT
UNTIL FLOAT IS PARALLEL
WITH TOP OF BOWL
(HOLDING BOWL UPSIDE DOWN)

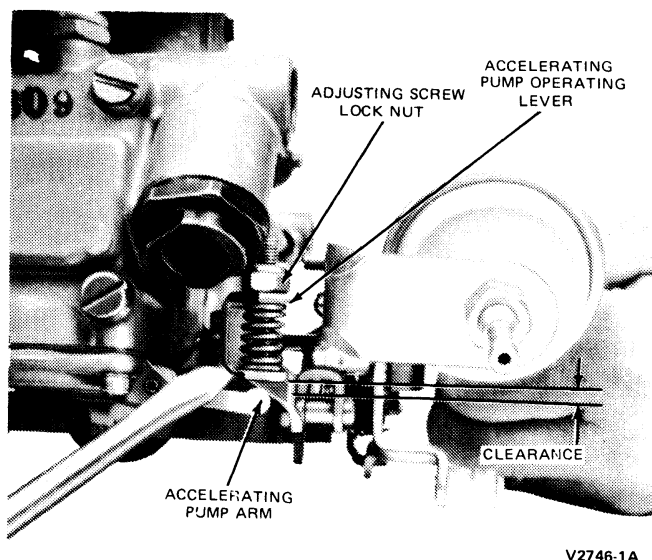
V2486-1B

FIG. 5 Adjusting Float—Dry

(Refer to Truck Performance Specifications manual or to the Engine Emission Control System decal on the engine for the proper setting.)

ACCELERATING PUMP LEVER ADJUSTMENT

1. Using a feeler gauge and with the throttle plates (primary throttle plates) in the wide open position, there should be the specified clearance between the accelerating pump operating lever adjustment screw head and the pump arm when the pump arm is depressed manually (Fig. 4).
2. If adjustment is required, loosen the adjusting screw locknut and turn the adjusting screw in to increase the clearance and out to decrease the clearance. One half turn of the adjusting screw is equal to



V2746-1A

FIG. 4 Accelerating Pump Lever Clearance—Holly Carburetors

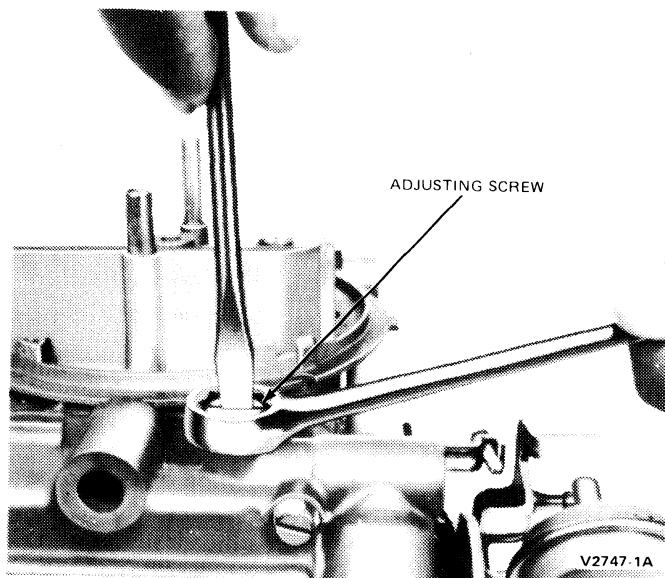


FIG. 6 Adjusting Fuel Level—Wet

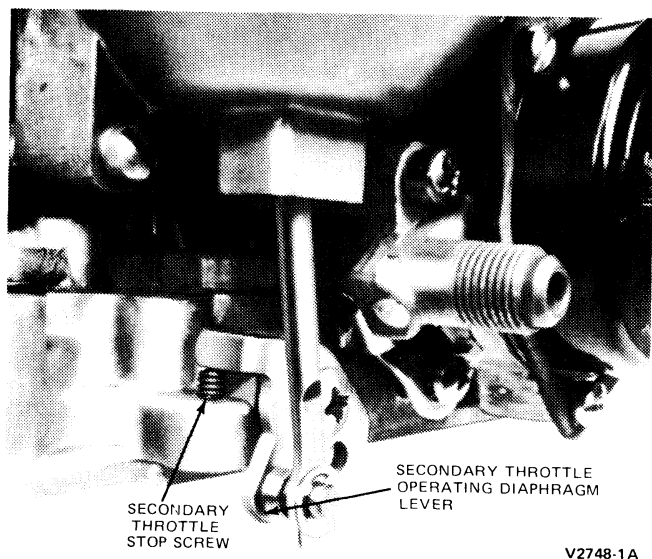


FIG. 7 Secondary Throttle Plate Adjustment

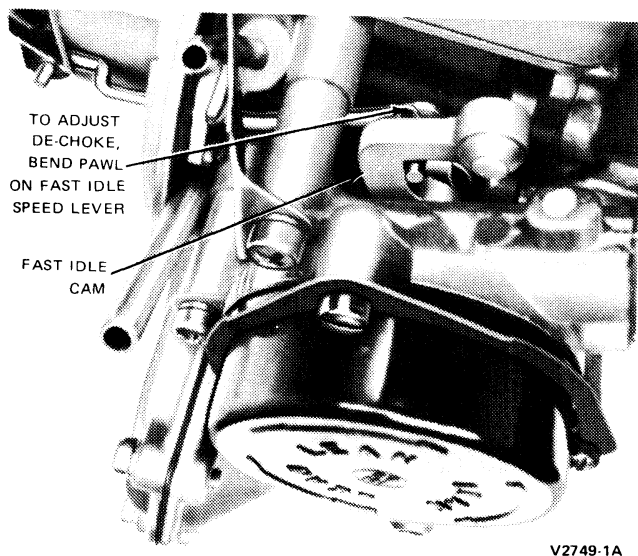


FIG. 8 Dechoke Clearance

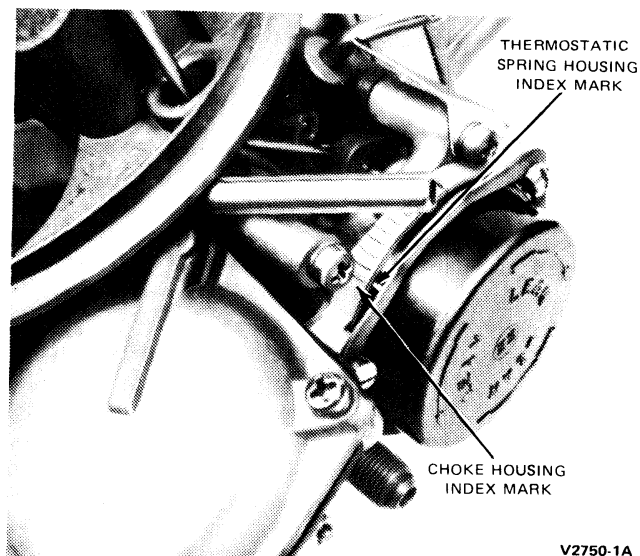


FIG. 9 Automatic Choke Thermostatic Spring Housing Adjustment

approximately 0.015 inch. When the proper adjustment has been obtained hold the adjustment screw in position with a wrench and tighten the locknut.

3. Perform an accelerating pump stroke adjustment, if required.

ACCELERATING PUMP STROKE ADJUSTMENT

The accelerating pump stroke has been set to help keep the exhaust emission level of the engine within the specified limits. The additional holes provided for pump stroke adjustment are for adjusting the stroke for specific engine applications. **The stroke should not be changed from the specified setting.**

If the pump stroke has been changed from the specified setting, refer to the following instructions to correct the stroke to specifications.

If a change in the adjustment is required, make certain the proper hole (top or bottom) in plastic accelerating pump cam, located behind the throttle lever, is properly aligned (indexed) with the numbered hole (top or bottom) in the throttle lever before installing the retaining screw.

FUEL LEVEL FLOAT ADJUSTMENT—DRY

The dry float adjustment is a preliminary fuel level adjustment only. The final adjustment (Fuel Level Float Adjustment—Wet) must be performed after the carburetor is installed on the engine.

With the fuel bowls and float assemblies removed, adjust the floats so that the floats are parallel to the fuel bowls, with the top of the fuel bowls inverted (Fig. 5).

FUEL LEVEL ADJUSTMENT—WET

The fuel pump pressure and volume must be to specifications prior to performing the following adjustments.

1. Operate the engine to normalize engine

temperatures and place the vehicle on a flat surface, as near level as possible. Remove the air cleaner, if it was not previously removed.

2. Check the fuel level in each bowl separately (Fig. 7). **Place a suitable container below the fuel level sight plug in the fuel bowl to collect any spillover of fuel. Carefully remove the fuel level sight plug and gasket. Check each fuel bowl separately. The fuel level within the bowl should be at the lower edge of the sight plug opening.**
3. **If the fuel level is satisfactory, install the sight plug.**
4. **If fuel level is too high**, loosen locknut at top of fuel bowl. **Loosen the lock screw only enough to allow rotation of the adjusting screw.** Turn the adjusting screw, (Fig. 6), clockwise to lower the fuel level sufficiently to have the fuel below the level of the sight plug. Then, turn the adjusting screw counterclockwise. The correct level is reached when the fuel can be seen just at the lower edge of the sight plug opening.
After each adjustment, tighten the lock nut, install the fuel level sight plug, and wait until the fuel level is stabilized. When correct fuel level is reached, install the sight plug and gasket.
5. **If the fuel level is too low**, loosen the lock nut and turn the adjusting screw **counterclockwise** until the fuel level is raised to the lower edge of the sight plug opening.

SECONDARY THROTTLE PLATE ADJUSTMENT

1. With carburetor off the engine, hold the secondary throttle plates closed.
2. Turn the secondary throttle shaft lever adjusting screw (stop screw) out (counterclockwise) until the secondary throttle plates seat in the throttle bores (Fig. 7).
3. Turn the screw in clockwise until the screw JUST contacts the secondary lever.

REMOVAL AND INSTALLATION

CARBURETOR

Removal

1. Remove the air cleaner. Remove the throttle rod from the throttle lever. Disconnect the distributor vacuum hose and PCV hose and the fuel line.
2. Disconnect choke heat tube.
3. Remove the carburetor retaining nuts and lockwashers, then remove the carburetor. Remove the spacer from the manifold.

Installation

1. Be sure all old gasket material is removed from the manifold heat riser flange, then place the spacer in position on the manifold. Position the carburetor on the manifold and install the lockwashers and

DECEL THROTTLE MODULATOR ADJUSTMENT

1. With engine at normal operating temperature, apply 19" Hg. vacuum to decel throttle modulator (use jumper hose to intake manifold vacuum source, or hand vacuum pump).
2. Loosen decel throttle modulator lock nut and rotate modulator to achieve 1800 RPM.

CHOKE PULLDOWN ADJUSTMENT

For pulldown adjustment, refer to Part 29-02 of this manual.

DECHOKE CLEARANCE

1. Open the throttle plate to the wide-open-throttle position and hold.
2. Rotate the choke plate towards the closed position until the pawl on the fast idle speed lever contacts the fast idle cam.
3. Check the clearance between the lower edge of the choke plate and the air horn wall, (Fig. 8).
4. Adjust the clearance to specifications by bending the pawl on the fast idle speed lever forward to increase or backward to decrease the clearance.

AUTOMATIC CHOKE THERMOSTATIC SPRING HOUSING ADJUSTMENT

1. Remove the air cleaner assembly.
2. Loosen the thermostatic spring housing clamp retaining screws. Set the spring housing to the specified index (Fig. 9) and tighten the clamp retaining screws.
3. If other carburetor adjustments are not required, install the air cleaner assembly on the carburetor.

nuts. Tighten the nuts alternately to 19-27 N·m (14-20 ft-lbs).

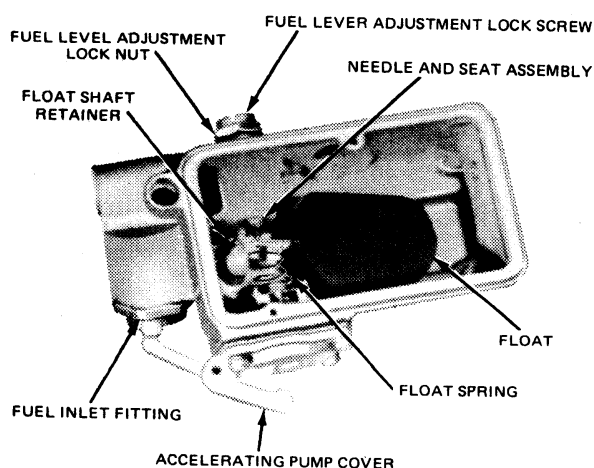
2. Connect the throttle rod. Connect the hand throttle control cable, the distributor vacuum hose and the fuel line. Adjust the idle speed, the primary and secondary fuel level, and the idle fuel mixture. Refer to Part 50-29 for procedures and to the Vehicle Emissions Control Information decal on the engine or the Truck Performance Specifications Manual for Specifications.

FUEL BOWL AND GASKET AND METERING BLOCK AND GASKET

Removal

1. Remove the fuel inlet line.

2. Place a suitable container under the fuel bowl and drain the bowl by loosening the fuel bowl retaining screws. Remove the container.
3. Remove the four fuel bowl retaining screws.
4. Remove the fuel bowl, gasket and metering block and gasket. Discard the gaskets (Fig. 10).



V2470-1B

FIG. 10 Fuel Bowl**Installation**

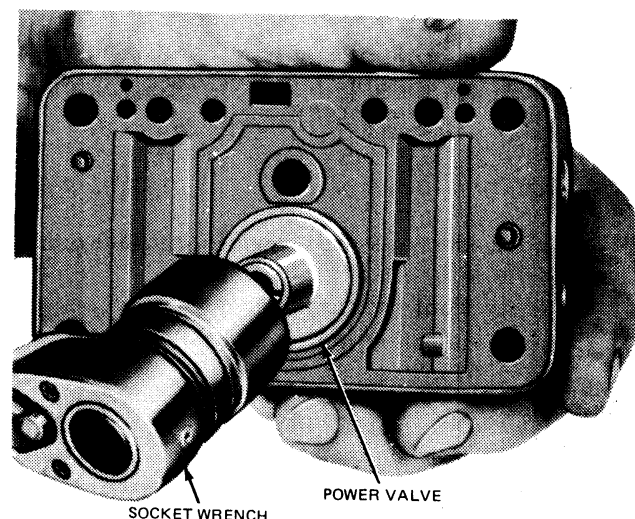
1. If the fuel bowl or metering block is being replaced, transfer the parts.
 2. Position the metering block gasket on the dowels on the back of the metering block.
 3. Lay the metering block in place on the main body.
Note: Make sure that the accelerator pump channel connector and its two "O" rings are in place on the metering block.
 4. Position the fuel bowl gasket on the metering block.
 5. Use light grease on transfer tube O-rings. Place the fuel bowl on the metering block while sliding transfer tube and O-ring into fuel passage in fuel bowl. Use new compression gaskets on the bowl retaining screws; then install and tighten the screws.
- CAUTION:** Use extreme care not to pinch O-ring(s) during installation. Pinched O-rings will result in fuel leaks.

POWER VALVE AND GASKET**Removal**

1. Remove the primary fuel bowl and primary metering block.
2. Using a socket wrench, remove the power valve and gasket (Fig. 11).
3. Discard the gasket.

Installation

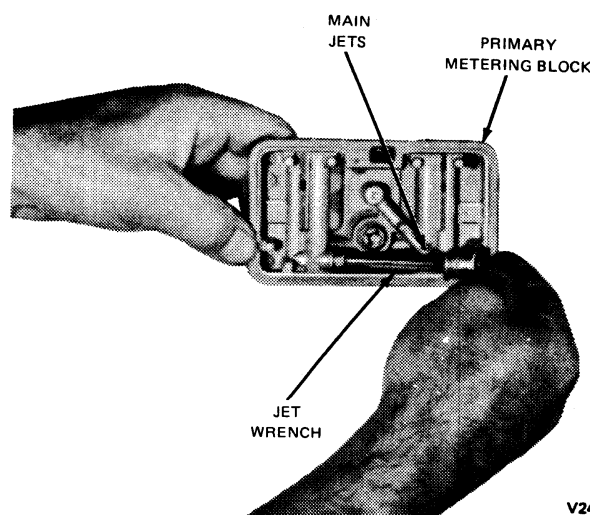
1. Place a new gasket on the specified power valve.
2. Using a socket wrench, install the power valve and gasket.
3. Install the fuel bowl and metering block.



V2471-1A

FIG. 11 Removing or Installing Power Valve MAIN JET**Removal and Installation**

1. Remove the fuel bowl and metering block.
2. Use a jet wrench to remove and install the jets (Fig. 12).



V2472-1B

FIG. 12 Removing or Installing Main Jet

3. Install the fuel bowl and metering block.

ACCELERATING PUMP DIAPHRAGM**Removal**

1. Remove the fuel bowl and metering block. If carburetor has been removed from the vehicle, then it is not necessary to remove the fuel bowl.
2. Remove the accelerating pump cover, diaphragm and spring (Fig. 15).

Installation

1. Place the spring and diaphragm in the accelerating pump chamber. The diaphragm must be positioned so that the diaphragm disc protrudes from the fuel bowl.

2. Install the cover screws finger tight.
3. Make sure the diaphragm is centered, compress the diaphragm with the pump operating lever and tighten the cover screws.

FLOAT

Removal

1. Using needle nose pliers, remove the float retainer clip (Fig. 13).
2. Slide the float off the shaft.
3. Remove the spring from the float.

Installation

1. Install the float spring on the float.
2. Slide the float on the shaft.
3. Install the float retainer clip.

FUEL INLET NEEDLE AND SEAT

Removal

The fuel inlet needle and seat assembly can be replaced without removing the fuel bowl.

1. Remove the air cleaner.
2. Remove the fuel level adjustment lock screw and gasket (Fig. 10). Turn the adjusting nut out and remove the adjusting nut and gasket. Remove the fuel inlet needle and seat assembly (Fig. 14). **Do not disassemble the fuel inlet needle and seat assembly. They are matched parts and are serviced as an assembly.**

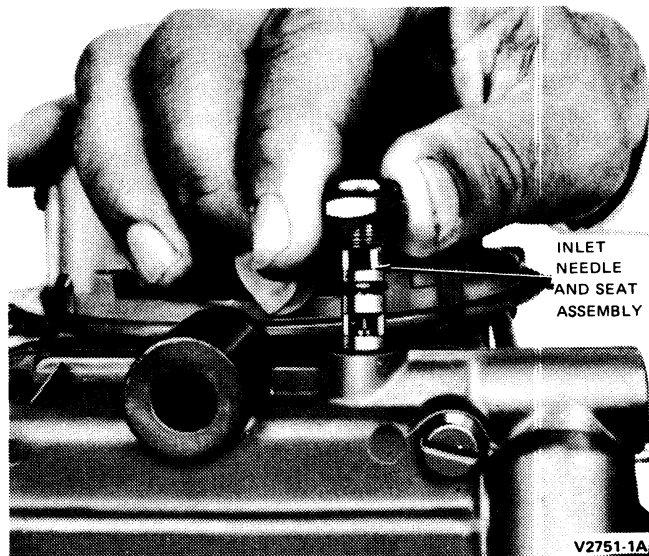
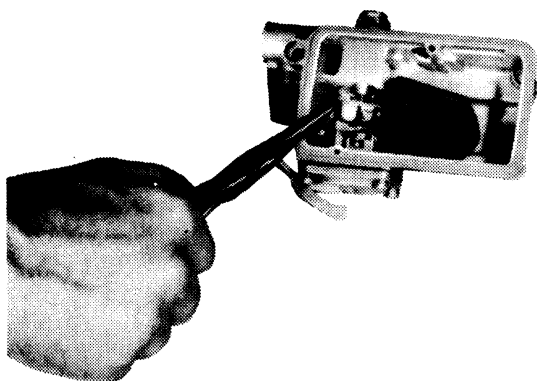


FIG. 14 Removing Fuel Inlet Needle and Seat

Installation

1. Position the fuel inlet needle and seat assembly in the fuel bowl.
2. Position the adjusting nut gasket and nut on the fuel inlet needle and seat assembly. Align the flat on the ID of the nut with the flat on the OD of the fuel inlet needle and seat assembly.
3. Install the fuel level adjustment lock screw and gasket.
4. Adjust the fuel level.



V2473-1B

FIG. 13 Removing Float Shaft Retainer Clip

DISASSEMBLY AND ASSEMBLY

CARBURETOR DISASSEMBLY

The carburetor disassembled view is shown in Fig. 15.

To facilitate working on the carburetor and to prevent damage to the throttle plates, install bolts about 2 1/4 inches long of the correct diameter through the carburetor retaining bolt holes with a nut above and below the flange (or install carburetor legs).

Use a separate container for the component parts of the various assemblies to facilitate cleaning, inspection, and assembly.

The following is a step-by-step sequence of operations for completely overhauling the carburetor; however, certain components of the carburetor may be serviced without disassembling the entire unit. For a complete carburetor overhaul, follow all the steps. To partially overhaul the carburetor or to install a new gasket kit, follow only the applicable steps. Refer to Part 24-01 for cleaning and inspection procedures.

PRIMARY FUEL BOWL AND METERING BLOCK

Refer to Fig. 10 for the correct location of the fuel bowl parts.

1. Remove the fuel bowl and gasket and the metering block and gasket. Discard the gaskets.
2. Remove the pump transfer tube from the main housing or metering block and discard the O-ring seals.
3. Remove the fuel line tube and discard the O-ring seal.
4. Using a jet wrench, remove the main jets (Fig. 12).
5. Using a socket wrench, remove the power valve and gasket (Fig. 11).
6. Remove the fuel level adjustment lock screw and gasket. Turn the adjusting nut counterclockwise and remove the adjusting nut and gasket. Remove the fuel inlet needle and seat assembly. **Do not disassemble the fuel inlet needle and seat. They are matched assemblies and are replaced as an assembly.**
7. Using needle-nose pliers, remove the float shaft retainer clip (Fig. 13). Slide the float off the shaft. Remove the spring from the float.
8. Remove the baffle plate from the fuel bowl.
9. Remove the fuel level sight plug and gasket.
10. Remove the fuel inlet fitting, gasket, and filter.
11. Invert the fuel bowl and remove the accelerating pump cover, diaphragm, and spring. The accelerating pump inlet ball check is not serviced separately and should not be removed.

SECONDARY FUEL BOWL AND METERING BODY

1. Remove the fuel bowl. Using a clutch-type screw driver, remove the metering body, plate, and gaskets (Fig. 16). Discard the gaskets.

2. Disassemble the fuel bowl by following Steps 6 thru 9 under Primary Fuel Bowl and Metering Block Disassembly in this section.

MAIN BODY

1. Remove the air cleaner anchor stud, and remove the secondary diaphragm link E-clip.
2. Invert the carburetor and remove the throttle body retaining screws and lock washers. Lift off the throttle body and discard the throttle body gasket.
3. Remove the choke rod cotter pin from the choke housing shaft and lever assembly. Remove the thermostatic spring housing and gasket; then, remove the choke housing and gaskets from the main body.

Remove the choke housing shaft nut, star washer, and spacer; then remove the shaft and fast idle cam. Remove the choke piston and lever assembly. Remove the choke rod and seal from the main body. If necessary, remove the choke plate from the choke shaft and slide the shaft and lever out of the air horn. **The retaining screws are staked to the choke shaft. If the tips of the screws are flared excessively, file off the flared portion to avoid damage to the threads in the choke shaft. Be careful not to damage the choke shaft or venturi while filing the screws.**

4. Remove three screws and then remove the secondary diaphragm housing and gasket from the main body. **The housing must be removed before the cover can be removed.** Remove the diaphragm housing cover; then remove the spring and diaphragm, and the vacuum ball check from the housing.
5. Remove the accelerating pump discharge nozzle screw; then lift the pump discharge nozzle and gaskets out of the main body. Invert the main body and let the accelerating pump discharge needle fall into the hand (Fig. 17).

THROTTLE BODY

Do not disassemble the throttle body. Parts are matched to meet emission control standards and must be serviced as an assembly (see Fig. 15).

CARBURETOR ASSEMBLY

Make sure all holes in the new gaskets have been properly punched and that no foreign material has adhered to the gaskets. Make sure the accelerating pump and secondary operating diaphragms are not cut or torn.

The carburetor assembly is shown in Fig. 15.

Throttle body must be replaced as an assembly as shown in Fig. 15.

MAIN BODY

1. Drop the accelerator pump discharge needle into its well (Fig. 18). Lightly seat the needle with a brass drift and light hammer.
2. Clean gasket mating surfaces on nozzle and main body.

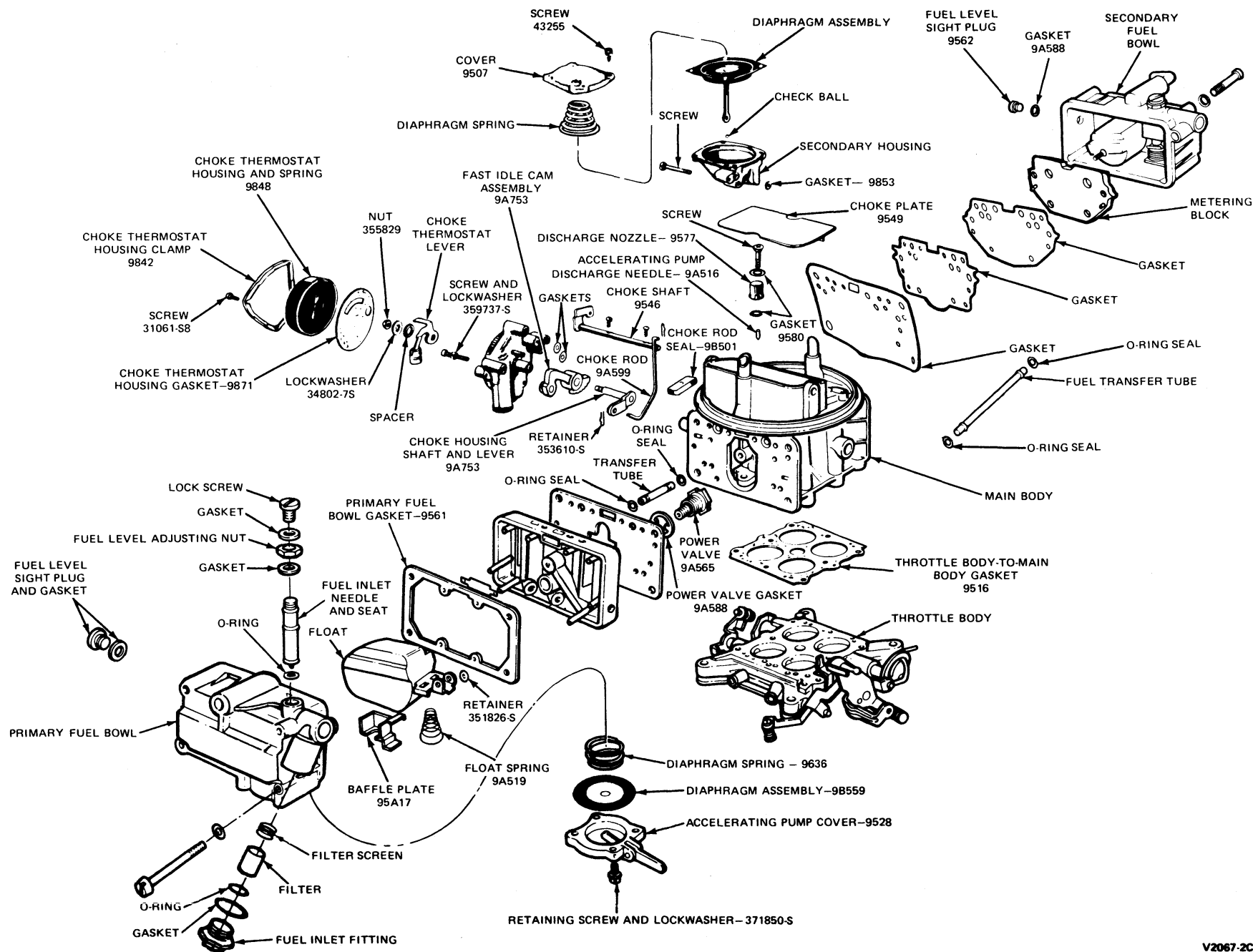
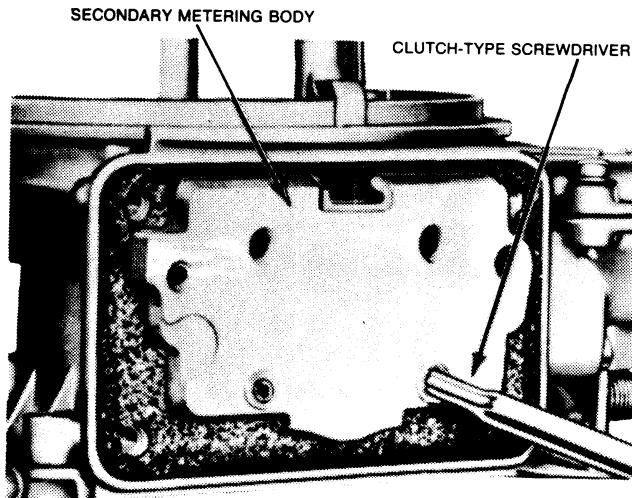
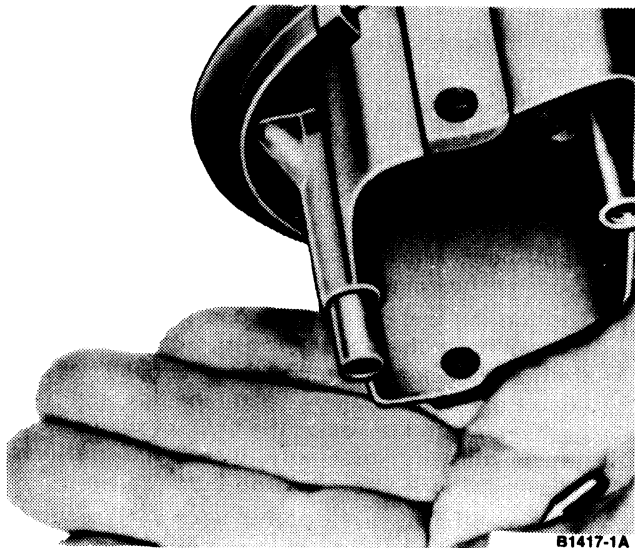


FIG. 15 Model 4180-C 4-V Carburetor Assembly



B1412-1B

FIG. 16 Secondary Metering Body Removal or Installation



B1417-1A

FIG. 17 Accelerating Pump Discharge Needle Removal

3. Position accelerator pump nozzle and gasket in main body and install retaining screw.

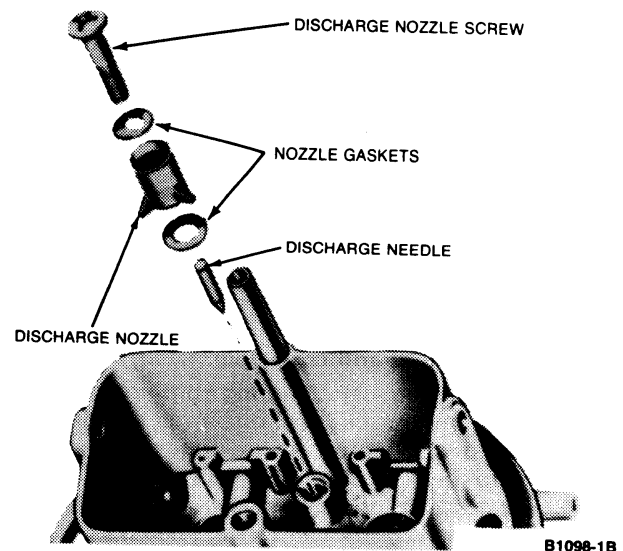
Note: Pump discharge gaskets, nozzle and screw must be installed before any other parts are installed to main body.

4. Using a flat punch, stake nozzle screw in position.

CAUTION: Do not use excessive force when staking nozzles screw.

CAUTION: Make certain that any chips from nozzle screw during staking are cleaned from carburetor throttle openings before continuing assembly.

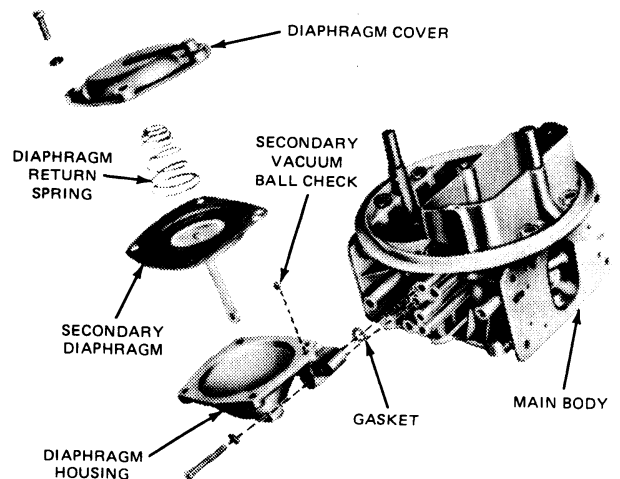
5. The secondary diaphragm housing must be installed before the choke housing. Drop the vacuum ball check in the vacuum port of the secondary diaphragm housing; then, position the secondary diaphragm in the housing and place the spring in the cover (Fig. 19). Install the cover and tighten the retaining screws finger-tight. Make sure



B1098-1B

FIG. 18 Accelerating Pump Discharge Assembly

that the diaphragm is seated evenly on the housing and that the vacuum opening is aligned. Install and tighten the cover attaching screws. **The diaphragm housing must be removed from the main body to install the cover.**



V1043-1B

FIG. 19 Secondary Diaphragm Assembly

6. Place the gasket on the secondary vacuum passage opening on the main body. Place the diaphragm housing in position on the main body and install the lock washers and retaining screws.
7. Position the choke plate shaft in the air horn and install the choke plate in the shaft (Fig. 20). Install the rod seal on the choke rod. Slide the U-shaped end of the choke plate rod through the opening in the main body and insert the rod end through the inner side of the bore in the choke lever. The rod end must face outward. Push the rod seal into the retaining grooves on the underside of the air cleaner mounting flange.

Position the choke thermostat lever link and piston assembly in the choke housing. Position the fast idle cam assembly on the choke housing and

install the choke housing shaft and lever assembly (Fig. 21). Position the lever and piston assembly on the choke housing shaft and lever assembly. Install the spacer, lock washer and nut.

Lay the main body assembly on its side and position the choke housing gaskets on the main body. Insert the choke rod in the choke housing shaft lever as the choke housing is placed into position on the main body. **Be sure the projection on the choke rod is placed under the fast idle cam, so that the cam will be lifted when the choke plate is closed.** Install the choke housing lock washers and screws. Using needle-nose pliers, install the choke rod cotter pin.

Place the thermostatic spring housing gasket into position on the choke housing, engaging the thermostatic spring on the spring lever; then install the housing, clamp and screws. Adjust the thermostatic spring housing by aligning the index mark on the cover with the specified mark on the choke housing.

8. Invert the main body and position the throttle body gasket on the main body. Place the throttle body on the main body. Slide the secondary diaphragm rod onto the operating lever as the throttle body is placed into position. Install the throttle body to main body screws and lock washers. Secure the secondary diaphragm rod with the retainer.
9. Install the air cleaner and anchor stud.

PRIMARY FUEL BOWL AND METERING BLOCK

Refer to Fig. 22 for the correct location of the fuel bowl parts.

1. Place the accelerating pump diaphragm spring and diaphragm in the accelerating pump chamber. The diaphragm must be positioned so that the large end of the rivet will be against the operating lever. Install the cover and tighten the retaining screws finger-tight. Make sure the diaphragm is centered, then compress the diaphragm with the pump operating lever and tighten the cover screws.
2. Install the filter, spring filter, gasket and fuel inlet fitting.

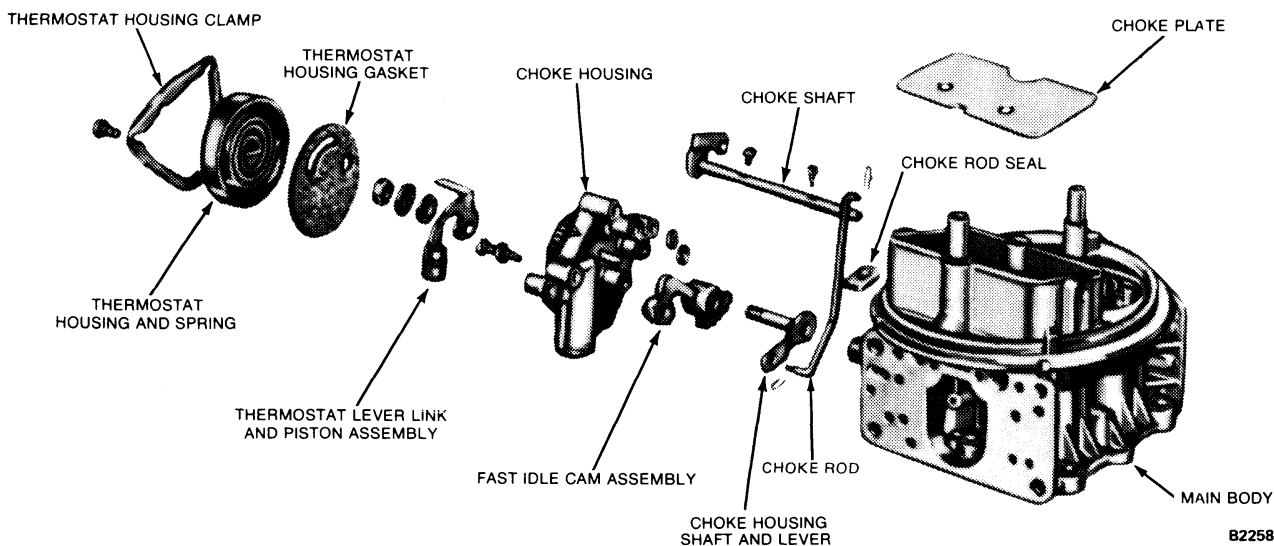
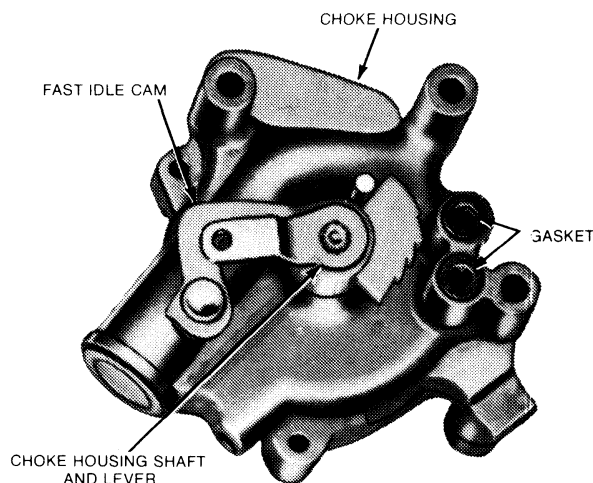


FIG. 20 Choke Plate and Housing Assembly



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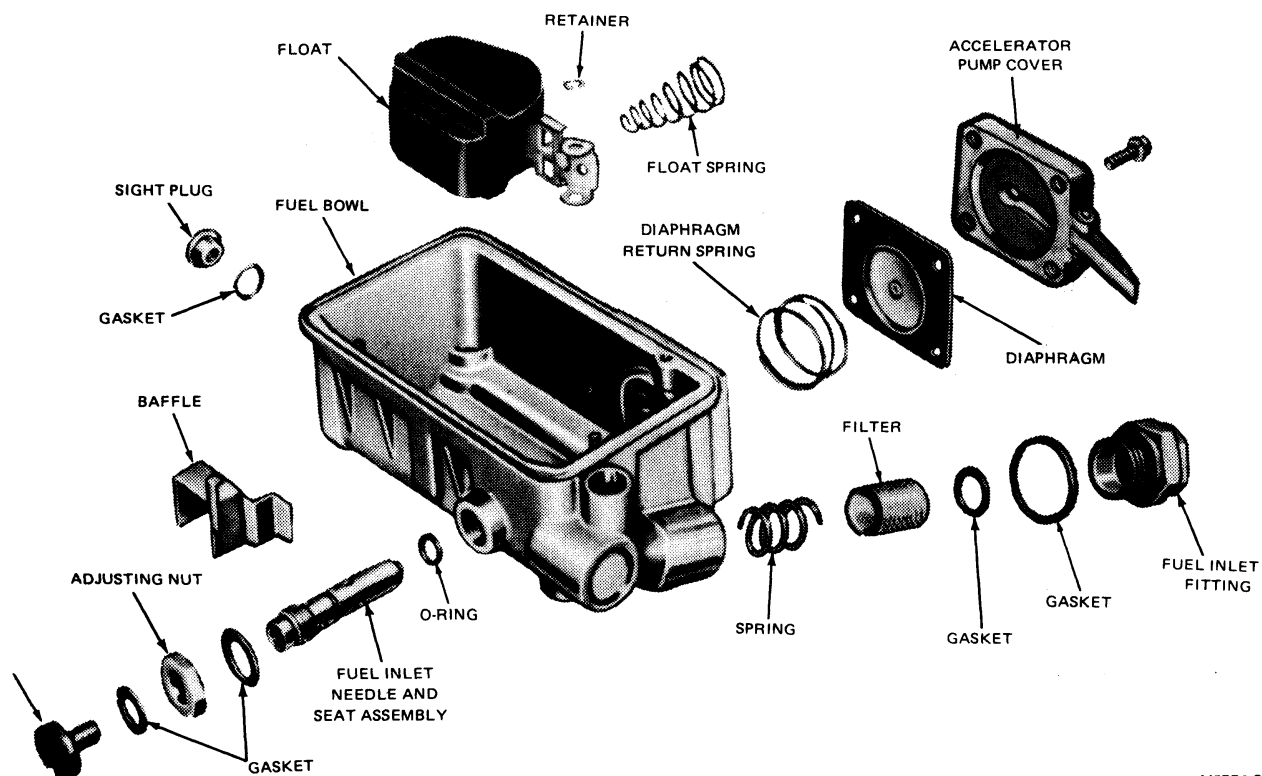
FIG. 21 Choke Housing Linkage Installation

3. Install the fuel level sight plug and gasket.
4. Slide the baffle plate onto the ridges in the fuel bowl.
5. Install the float spring on the float and slide the float onto the shaft.

Be sure the float spring is between the ridges on the boss on the floor of the fuel bowl. Using needle-nose pliers, install the float E-clip.

6. Apply petroleum jelly to a new O-ring seal and slide it on the fuel inlet needle and seat assembly.
7. Position the fuel inlet needle and seat assembly in the fuel bowl, through the top of the bowl. Position the adjusting nut gasket and the nut on the fuel inlet needle and seat assembly. Align the flat on the I.D. of the nut with the flat on the O.D. of the fuel inlet needle and seat assembly. Install the fuel level adjustment lock screw and gasket.
8. As a preliminary float adjustment, refer to Adjustments and Repairs and perform the Float Adjustment—Dry procedure.

B2258-2D



V2551-2B

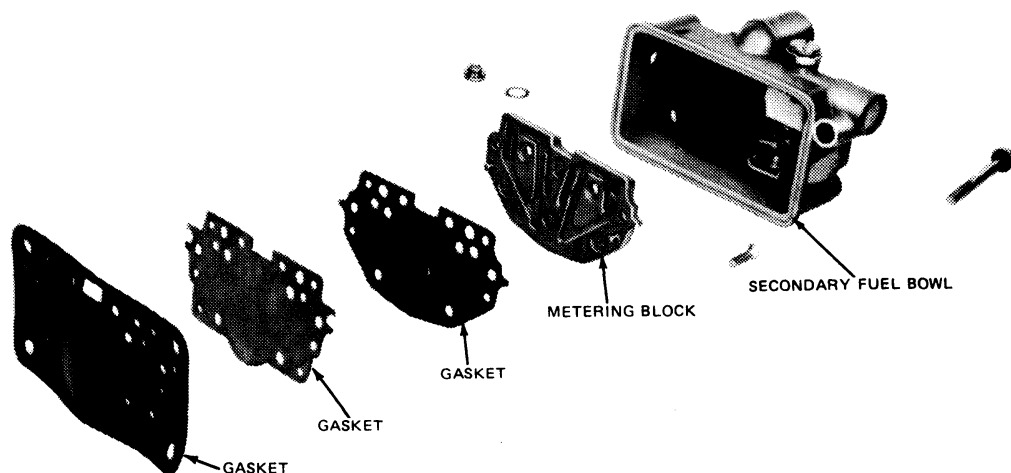
FIG. 22 Primary Fuel Bowl Assembly

9. Using a socket wrench, install the power valve and gasket in the metering block (Fig. 11). **Be sure to install the correct power valve. Refer to the specifications for the correct identification number. The number is stamped on a flat on the base of the valve.**
10. Install pump transfer tube and new O-rings in the metering block.
11. Using a jet wrench, install the jets in the metering block (Fig. 12).
12. Position the metering block gasket on the dowels located on the back of the metering block. Position the metering block and gasket on the main body. Position the gasket on the metering block. Place the retaining screws and new compression gaskets in the fuel bowl. Position the bowl in place on the metering block and tighten the retaining screws.
13. Apply petroleum jelly to the fuel line tube O-ring seal. Place seal against the flange on one end of the fuel line tube. Install this end of the fuel line tube into the recess in the primary fuel bowl.

Note: Inspect O-rings to ensure they are not pinched.

SECONDARY FUEL BOWL AND METERING BODY

1. Assemble the secondary fuel bowl and perform a float adjustment—dry.
2. Slide the metering body gasket (Fig. 23) on the balance tube and into position on the main body. Position the metering plate, gasket, and metering body on the main body, and install the retaining screws. Adjust the balance tube so that the distance from the metering body to the end of the balance tube is one inch.
3. Apply petroleum jelly to the fuel line tube O-ring seal and position it against the flange on the fuel line tube. Position the fuel bowl on the main body, guiding the fuel line tube into the recess in the bowl. Install the retaining screws with new compression gaskets.
4. Refer to Adjustments and perform the accelerating pump lever, accelerating pump stroke and automatic choke adjustments.



V2742-2A

FIG. 23 Secondary Fuel Bowl and Metering Body Assembly

SPECIFICATIONS

Adjustment procedures and service instructions for this carburetor are contained in Part 29-02 of this manual and in Part 59-29 of the Pre-Delivery, Maintenance and Lubrication Manual. Specifications are located in the Truck Performance Specifications Manual.

A typical Vehicle Emission Control Information decal is shown below (Fig. 24). This decal is located on the engine and lists many of the specifications required for engine timing, idle, fuel mixture, etc.

FORD MOTOR COMPANY				EVAPORATIVE FAMILY IS	
VEHICLE EMISSION CONTROL INFORMATION				VACUUM HOSE ROUTING	
ENGINE FAMILY		TRANS		SPARK PLUG	
ENGINE DISPLACEMENT		NEUTRAL		GAP	
SHIFT SCHED		TRANSMISSION GEAR		CATALYST	
		NEUTRAL			
		DRIVE			
BY PASS VALVE VACUUM HOSE AND CONNECT A VACUUM HOSE FROM MANIFOLD VACUUM TO THE BYPASS VALVE (AIR BPV)					
ADJUST IGNITION TIMING AND TIMING RPM TO SPEC. WITH VACUUM HOSE(S) DISCONNECTED AND PLUGGED AT THE DISTRIBUTOR. IF EQUIPPED WITH A THROTTLE SOLENOID POSITIONER DASHPOT DISCONNECT SOLENOID WIRE AND COLLAPSE THE DASHPOT. SET RPM USING CARBURETOR SET SCREW.					
FAST IDLE - ADJUST RPM TO SPEC. WITH TRANS IN NEUTRAL (M/T) OR PARK (A/T). FAST IDLE CAM IN SPECIFIED POSITION. D/P EGR VALVE VACUUM HOSE AT A. D/P PURGE VALVE VACUUM HOSE AT B.					
CURB IDLE - ADJUST RPM TO SPEC. WITH TRANS IN SPECIFIED MODE AND ALL VACUUM HOSES CONNECTED EXCEPT BYPASS VALVE. THROTTLE SOLENOID POSITIONER ENERGIZED AND DASHPOT COLLAPSED. IF SO EQUIPPED.					
TSP OFF - ADJUST RPM TO SPEC. WITH THROTTLE SOLENOID POSITIONER WIRE DISCONNECTED AND THE DASHPOT COLLAPSED. IF SO EQUIPPED.					
IDLE MIXTURE IS PRESET AT FACTORY. NOT ADJUSTED DURING SCHEDULED MAINTENANCE.					
COMPLIANCE DEMONSTRATED BELOW 4000 FT.					
THIS VEHICLE CONFORMS TO U.S. EPA REGULATIONS APPLICABLE TO 1980 MODEL YEAR NEW MOTOR VEHICLES.					

CHOKE SETTING SPECIFICATION

FAST IDLE RPM SPECIFICATION

CURB IDLE RPM SPECIFICATION

THROTTLE SOLENOID POSITIONER OFF RPM SPECIFICATION (IF SO EQUIPPED)

ADJUSTMENT PROCEDURE NOTES

V2733-2A

FIG. 24 Typical Vehicle Emission Control Information Decal

Fuel Pump — Mechanical

PART 24-30

APPLIES TO ALL ENGINES EXCEPT 7.8L (475/477 CID) V-8 AND 8.8L (534 CID) V-8

SUBJECT	PAGE	SUBJECT	PAGE
DESCRIPTION	24-30-1	SPECIFICATIONS	24-30-3
REMOVAL AND INSTALLATION		TESTING	24-30-2
Fuel Pump Assembly	24-30-2	Capacity (Volume) Test	24-30-2
		Pressure Tests	24-30-2

DESCRIPTION

Single-action mechanical fuel pumps are standard equipment for all engines.

The mechanical fuel pumps on 6-cylinder engines are mounted on the lower, left-center of the engine cylinder block.

On all V-8 engines, the mechanical fuel pumps are mounted on the left side of the cylinder front cover.

The engines also use permanently-sealed fuel pumps (Figs. 1 and 2), but with separate in-line fuel filters.

The fuel pumps are mechanically actuated by means of the fuel pump rocker arm and an eccentric on the camshaft.

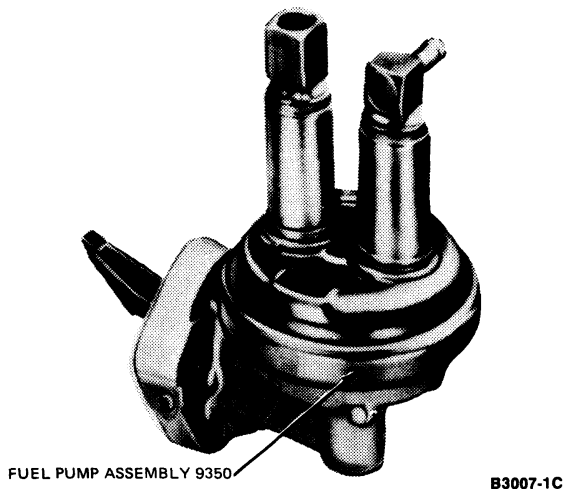


FIG. 1 Carter Permanently-Sealed Fuel Pump for Six Cylinder Engines

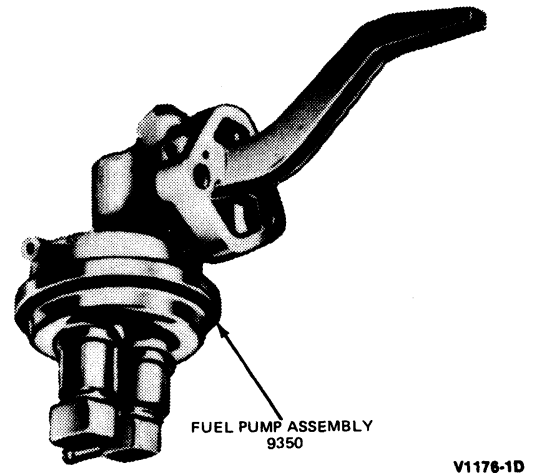


FIG. 2 Carter Permanently Sealed Fuel Pump for 5.0L (302 CID) V-8/5.8L (351 CID) W V-8, 5.8L (351 CID) M V-8, 6.6L (400 CID) V-8 and 7.5L (460 CID) V-8 Engines

TESTING

To determine that the fuel pump is in satisfactory operating condition, tests for both fuel pump pressure and fuel pump capacity (volume) should be performed.

The tests are performed with the fuel pump installed on the engine and the engine at normal operating temperature at idle speed.

Before the tests, make sure the replaceable fuel filter has been changed within the recommended

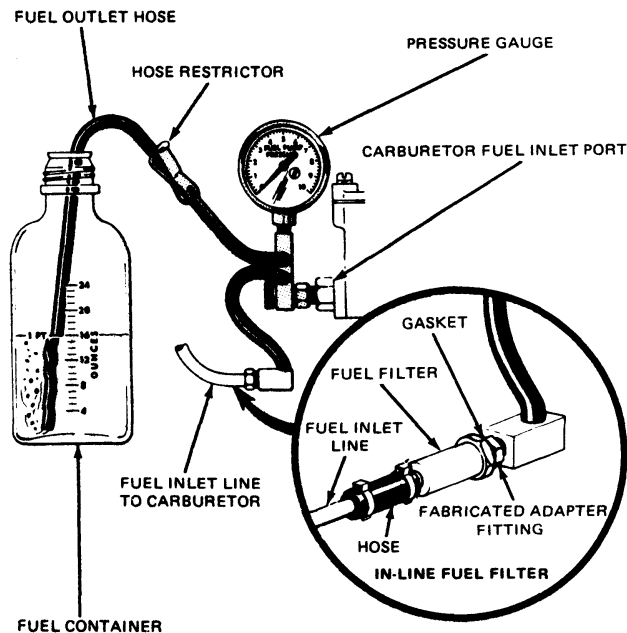
maintenance mileage interval. When in doubt, install a new filter.

PRESSURE TESTS

Refer to the fuel pump specification in this Part, and note the fuel pump pressure and capacity (volume) design tolerances.

1. Remove the air cleaner assembly. Disconnect the fuel inlet line or the fuel filter at the carburetor. **Use care to prevent combustion due to fuel spillage.**
2. Connect pressure gauge, restrictor and flexible hose (Fig. 3) furnished with Rotunda fuel pump tester (model 780021), or equivalent, between the fuel filter and carburetor.

NOTE: Inside diameter of smallest passage in test flow circuit must not be smaller than .220.



B2630-1B

FIG. 3 Typical Fuel Pump Pressure and Capacity Test Equipment

3. Position the flexible fuel outlet hose and the restrictor so the fuel can be discharged into graduated container (Fig. 4) furnished with Rotunda fuel pump tester (model 780021) or equivalent.
4. Before taking a pressure reading operate the engine at the specified idle rpm and vent the system into the container by opening the hose restrictor momentarily.
5. Close the hose restrictor, allow the pressure to stabilize, and note the reading. Refer to the Specifications Section in this Part.

If the pump pressure is not within specifications, and the fuel lines and filter are in satisfactory condition, the pump is worn or damaged and should be replaced.

If the pump pressure is within specifications, perform the tests for fuel capacity (volume).

CAPACITY (VOLUME) TEST

With the fuel pump pressure within specifications, test the capacity (volume) as follows:

1. Operate the engine at the specified idle rpm.
2. Open the hose restrictor and expel the fuel into the container (Fig. 3), while observing the time required to expel one pint. Close the restrictor. One pint or more of fuel should be expelled within the specified time limit.

If the pump volume is below specifications, repeat the test using an auxiliary fuel supply and a new fuel filter. If the pump volume meets specifications while using the auxiliary fuel supply, check for a restriction in the fuel supply from the tank and for the tank not venting properly.

REMOVAL AND INSTALLATION

FUEL PUMP ASSEMBLY

Removal

1. Disconnect the inlet and outlet lines at the fuel pump.
2. Remove the pump attaching screws, then remove the pump and the gasket. Discard the gasket.

Installation

1. Remove all the gasket material from the mounting pad and pump flange. Apply oil-resistant sealer to both sides of a new gasket and to the threads on the attaching bolts.

2. Position the new gasket on the pump flange and hold the pump in position against the mounting pad. Make sure the rocker arm is riding on the camshaft eccentric. (Turn engine over until the fuel pump eccentric is on the low side of the stroke.)
3. Press the pump tight against the pad, install the attaching screws and alternately tighten them to 26-36 N·m (19-27 ft-lbs).
4. Connect the fuel inlet and outlet lines.
5. Operate the engine and check for leaks.

SPECIFICATIONS

FUEL PUMP — MECHANICAL

Engine Displacement (Cubic Inches)	Static Pressure (P.S.I.) ^①	Volume Flow — Minimum ① ②	Eccentric Total Lift (Inch.)
4.9L (300 CID) I-6	5.0-7.0	1 Pt. in 20 Seconds	.290-310
5.0 (302 CID) V-8, 5.8L (351 CID) W V-8	6.0-8.0		.690-.710
5.8L (351 CID) M V-8, 6.6L (400 CID) V-8	6.0-8.0		.602-.622
7.5L (460 CID) V-8	6.0-8.0		.890-.910
6.1L (370 CID) V-8 7.0L (429 CID) V-8	6.0-8.0		.690-.710

① On engine, with temperatures normalized, and at normal curb idle speed, in neutral.

② Inside diameter of smallest passage in test flow circuit must not be less than 0.220 inch.

Fuel pump to engine attaching screws — 26-36 N•m (19-27 ft-lbs) torque.

CV1076-2L

SPECIAL SERVICE TOOLS

Number	Description
780021-Rotunda (or equivalent)	Fuel Pump Tester

CV2454-1A

Air Cleaner — Dry Type

PART 24-41

APPLIES TO ALL MODELS

SUBJECT	PAGE	SUBJECT	PAGE
DESCRIPTION	24-41-1	REMOVAL AND INSTALLATION	24-41-1

DESCRIPTION

Dry type air cleaners are standard on F-100 through F-350 series, Bronco and E-100—E-350 series vehicles.

Air passes into the air cleaner and through a chemically treated and pleated paper element before entering the engine induction system. The air cleaner

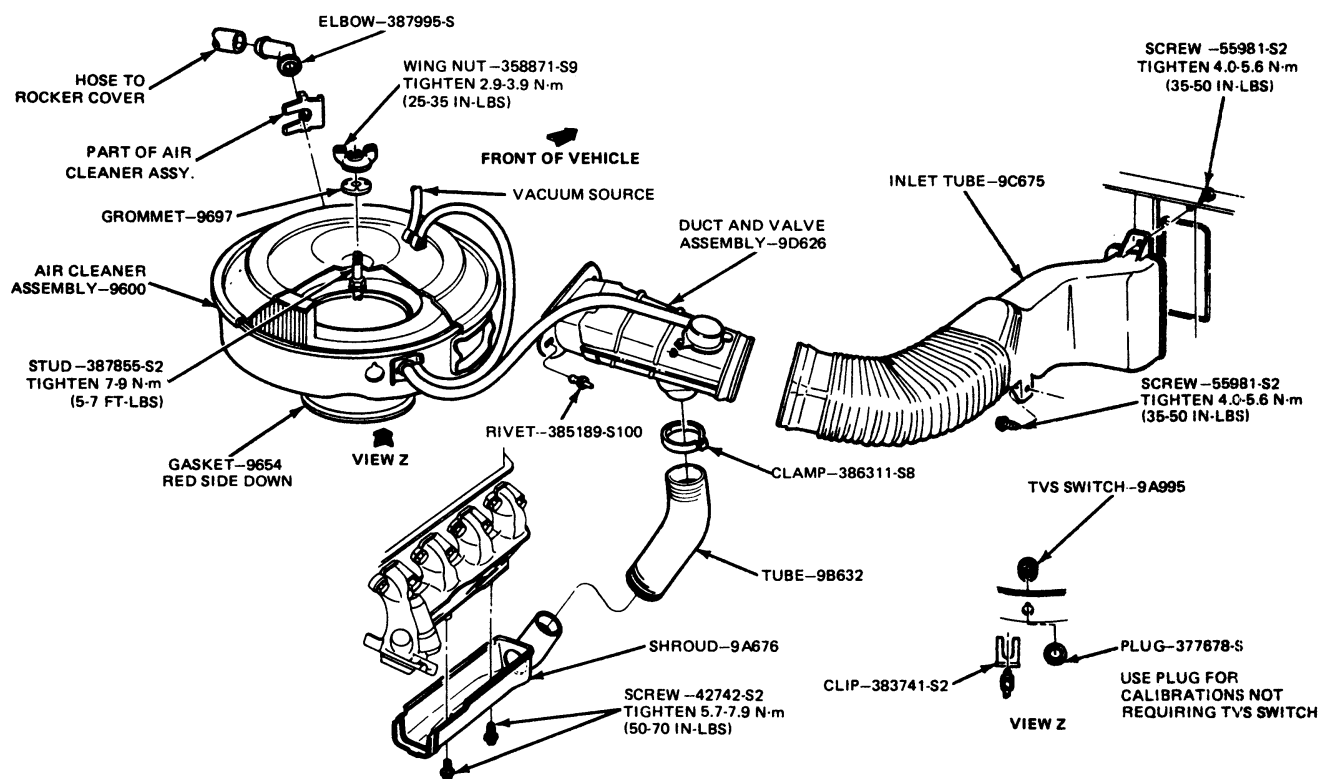
system has a heat sensor mounted in the cleaner assembly to control the carburetor air cleaner.

In some cases a "cold weather modulator" or "delay valve" is also added, for improved emission control during cold ambient temperatures.

REMOVAL AND INSTALLATION

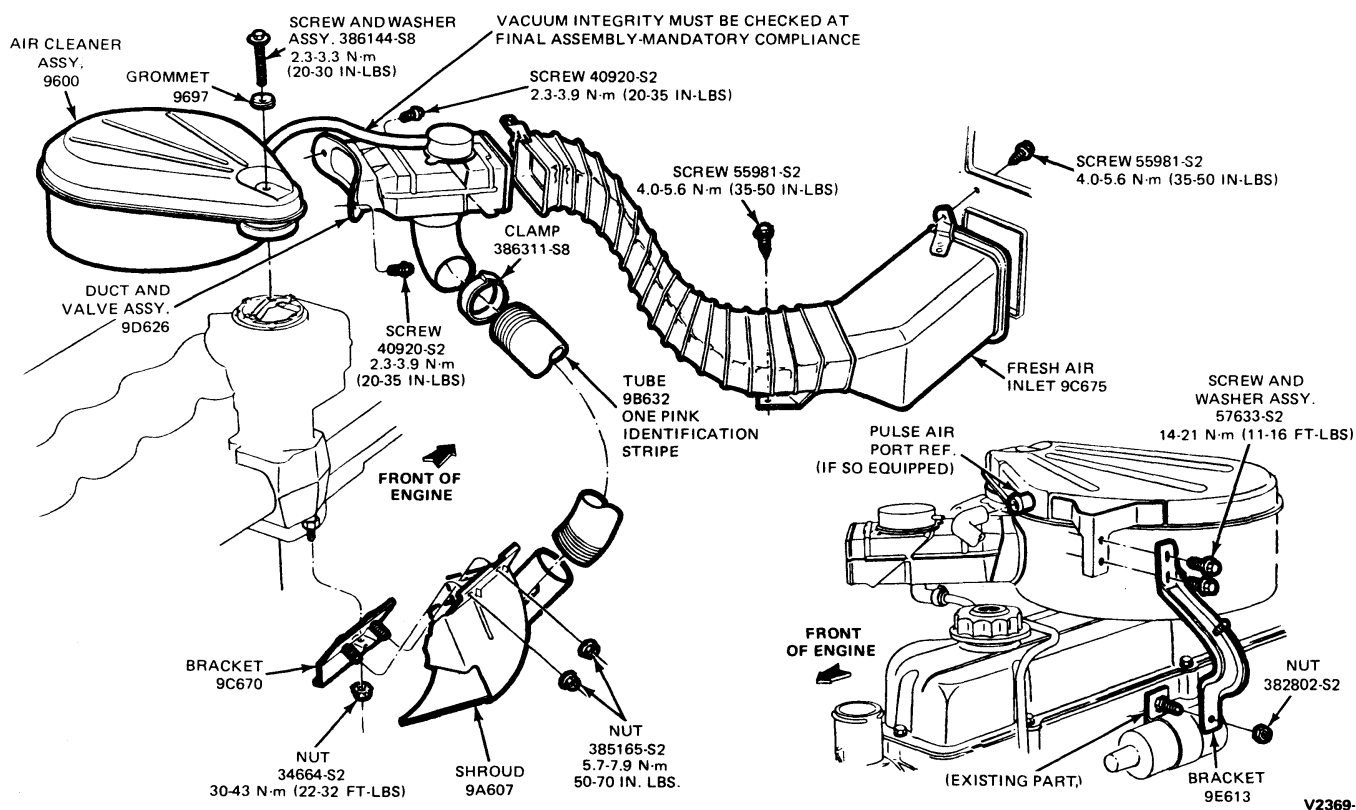
Illustrations of the various types of air cleaners for the vehicle models and engine applications are shown in this part. Reference to the illustrations will enable the

service technician to perform the required removal and installation and/or repair operations.



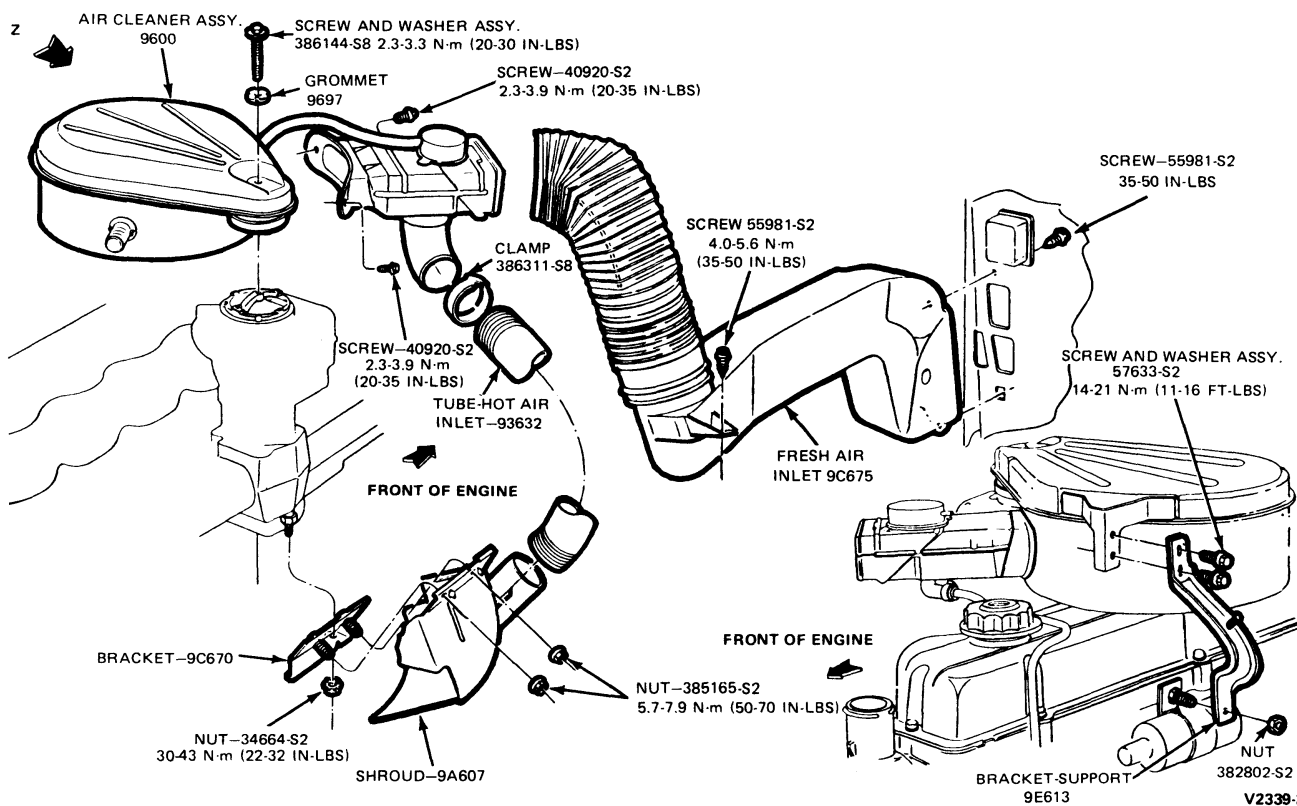
V2649-2A

FIG. 1 Typical Installation for F-100—F-350—5.0L (302 CID) V-8 Engine Shown, 5.8L (351 CID)-M V-8 and 6.6L (400 CID) V-8 Engines Similar



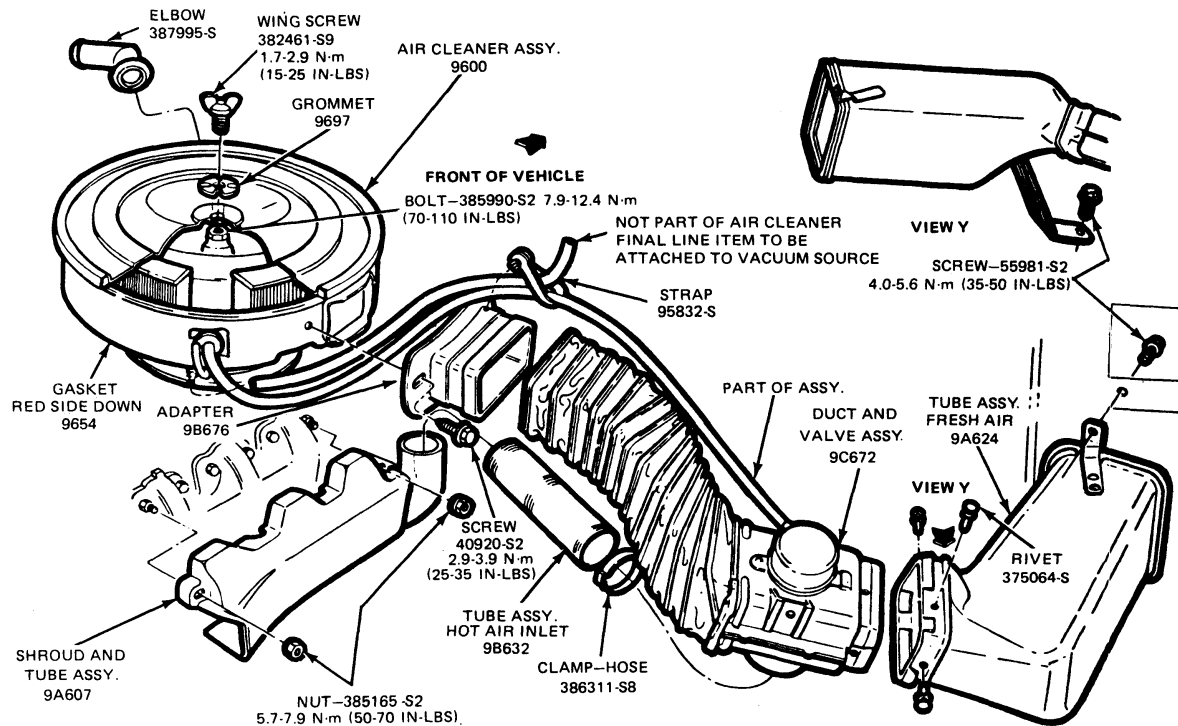
V2369-2C

FIG. 2 Typical Installation for F-Series 4.9L (300 CID) I-6 Engine



V2339-2C

FIG. 3 Typical Installation for E-Series with 4.9L (300 CID) I-6 Engine



V2341-2C

FIG. 4 Typical Installation for E-100—E-350—5.0L (302 CID) V8, 5.8L (351 CID)-M V-8, 5.8L (351 CID)-W V-8, 6.6L (400 CID) V-8 Engines

Air Cleaner Duct Systems

PART 24-42

APPLIES TO ALL MODELS

SUBJECT	PAGE	SUBJECT	PAGE
DESCRIPTION	24-41-1	REMOVAL AND INSTALLATION	
Vacuum-Operated Duct Valve	24-42-1	Duct and Valve Assembly —	
		Vacuum Operated	24-42-2

DESCRIPTION

Fresh air or heated air from a shroud around the exhaust manifold is made available to the engine air intake through a system of ducting. The selection of air of a desired temperature is made by a temperature-sensitive vacuum system that operates the duct valve.

VACUUM-OPERATED DUCT VALVE

A temperature sensor, located in the air cleaner assembly, controls the operation of the vacuum motor that operates the duct valve (Fig. 1).

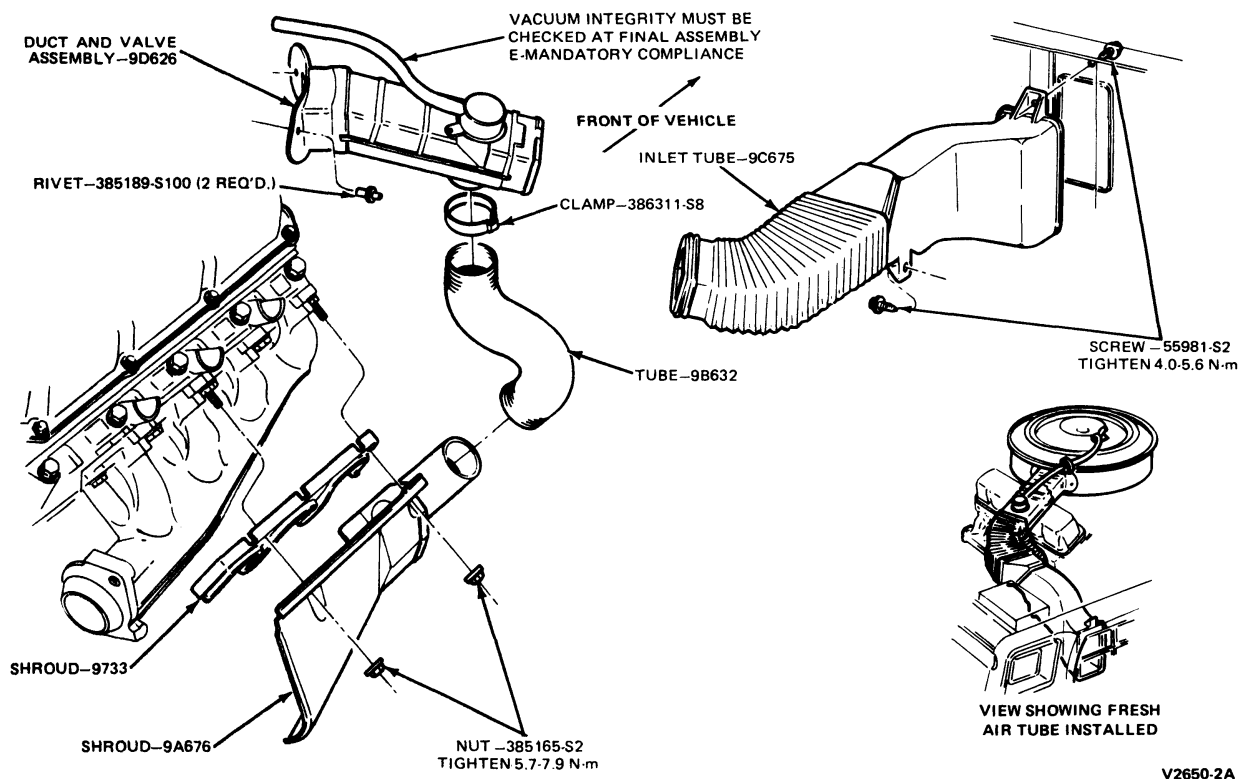
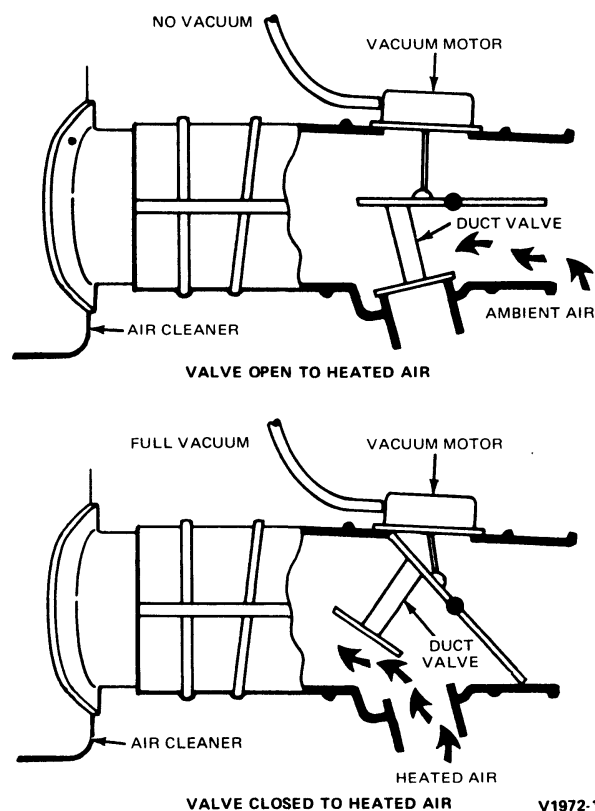


FIG. 1 Vacuum-Operated Duct System—(F-100—F-350, Bronco, 5.8L (351 CID)-M, 6.6L (400 CID) Shown, E-100—E-350—Similar)

The vacuum-operated duct system can select either warm air from shrouding around the exhaust manifold, or cool air from an outside air pickup tube. When the engine is cold, air is selected from the exhaust manifold shroud because the heat sensor in the air cleaner is cold and vacuum is applied to the vacuum motor that operates the duct valve (Fig. 2).

As the engine warms, and air entering the air cleaner warms, the sensor operates, preventing vacuum from being applied to the vacuum motor on the duct valve. This opens the duct valve and allows pickup of cooler ambient air from the outside air pickup tube.

A cold-weather modulator, inserted in the air cleaner on some models, controls operation of the duct valve



under some air temperature conditions, for improved emission characteristics.

To determine whether the system is operating properly, testing procedures should be followed.

FIG. 2 Operation—Vacuum-Operated Duct Valve

REMOVAL AND INSTALLATION

DUCT AND VALVE ASSEMBLY—VACUUM OPERATED

Removal

1. Disconnect the vacuum hose at the vacuum motor.
2. Remove either the hex cap screws or the pop rivets that secure the air intake duct and valve assembly to the air cleaner. The cap screws should be removed in the normal manner; the pop rivets can only be removed by grinding the rivet heads off and punching the rivet out.

3. Remove the duct and valve assembly from the engine.

Installation

1. Position the duct and valve assembly to the air cleaner and heat stove tube. Reinstall the previously removed cap screws, or when required, install new pop rivets.
2. Connect the vacuum line at the vacuum motor.

Fuel Tanks and Lines and Fuel Evaporative Emission Control System

PART 24-50

APPLIES TO ALL MODELS

SUBJECT	PAGE	SUBJECT	PAGE
DESCRIPTION		REMOVAL AND INSTALLATION (Cont'd.)	
Fuel Evaporative Emission Control System	24-50-1	Filler Pipes	
Carbon Canister	24-50-12	E-100, E-350 Vans and Club Wagons	24-50-18
California Fuel System —		Filler Pipe In-Frame	
Gasoline Engine	24-50-12	Fuel Tanks	24-50-18
Fuel Filler Cap	24-50-1	Fuel Lines	
Orifice Valve	24-50-12	Metal	24-50-18
Fuel and Vapor Hoses	24-50-13	Fuel Tanks E-100, E-350	24-50-16
Fuel Selector Valve	24-50-13	Aft Axle Body Mounted Tanks	24-50-16
Fuel Tank Draining	24-50-13	Aft Axle Frame Mounted Tank	24-50-16
Fuel Tank Filling	24-50-13	Midship Tank	24-50-17
Gasoline Octane Rating	24-50-12	Midship Fuel Tank	24-50-15
DIAGNOSIS AND TESTING		Selector Valve — Auxiliary Fuel Tank F-100 — 350 and E-100 — E-350	24-50-19
Diagnosis Guides	24-50-13	SPECIFICATIONS	24-50-20
REMOVAL AND INSTALLATION			
Aft-of-Axle Fuel Tank	24-50-15		
Bronco Fuel Tank	24-50-17		

DESCRIPTION

FUEL EVAPORATIVE EMISSION CONTROL SYSTEM

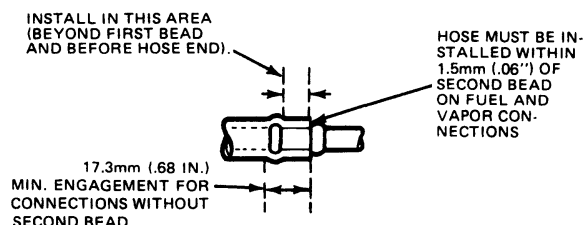
All Bronco, and F-100 through F-250 vehicles and F-350 in California, and E-100 through E-250 and E-350 in California are equipped with fuel evaporative emission control. This system is designed to limit fuel vapors released to the atmosphere. Figs. 3 through 9 show fuel line routings and tank installations.

GASOLINE SYMBOL DESIGNATION



FIG. 1 Gasoline Symbol Designation

V2022-1A

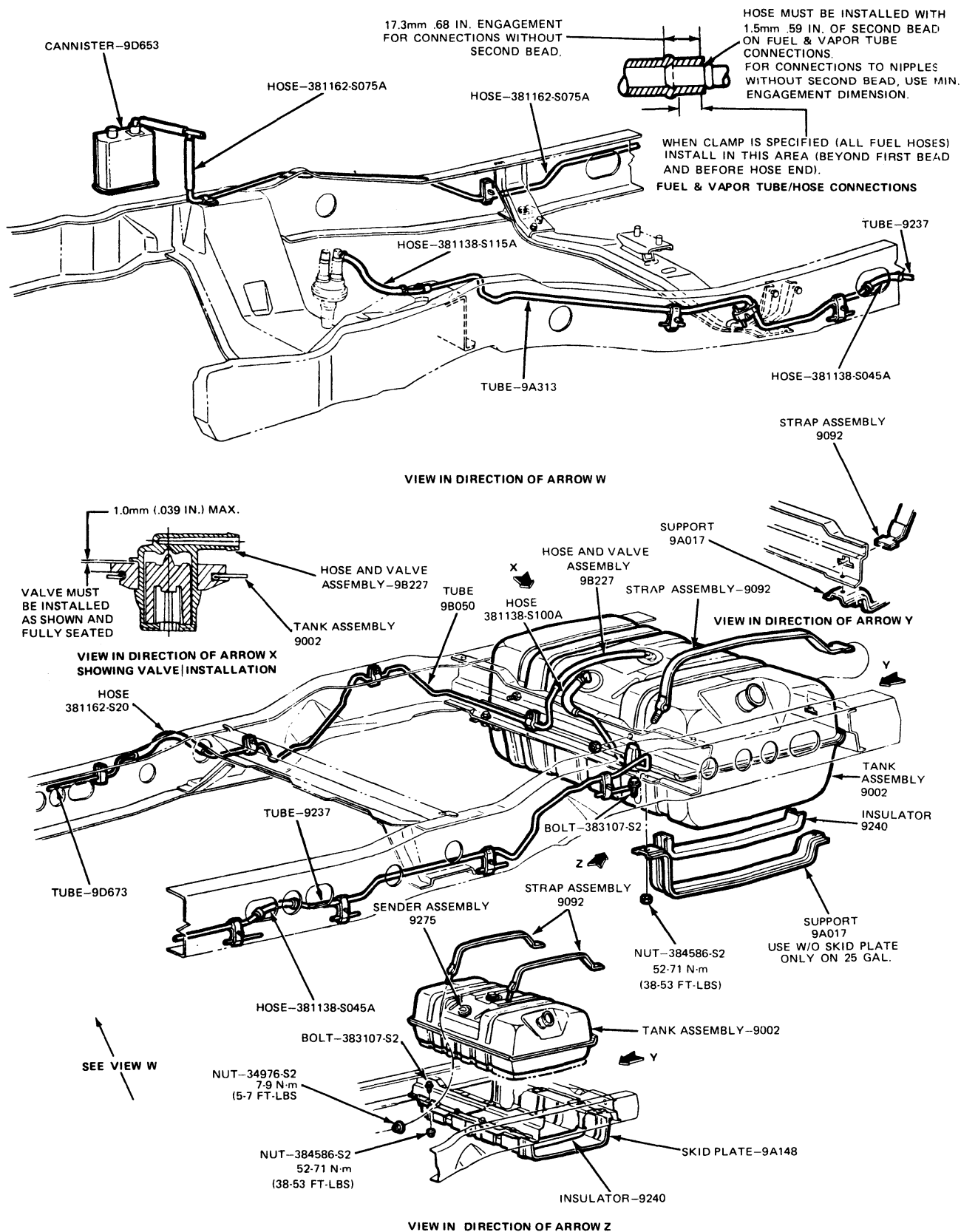


V2351-1B

FIG. 2 Fuel Hose Connections

FUEL FILLER CAP

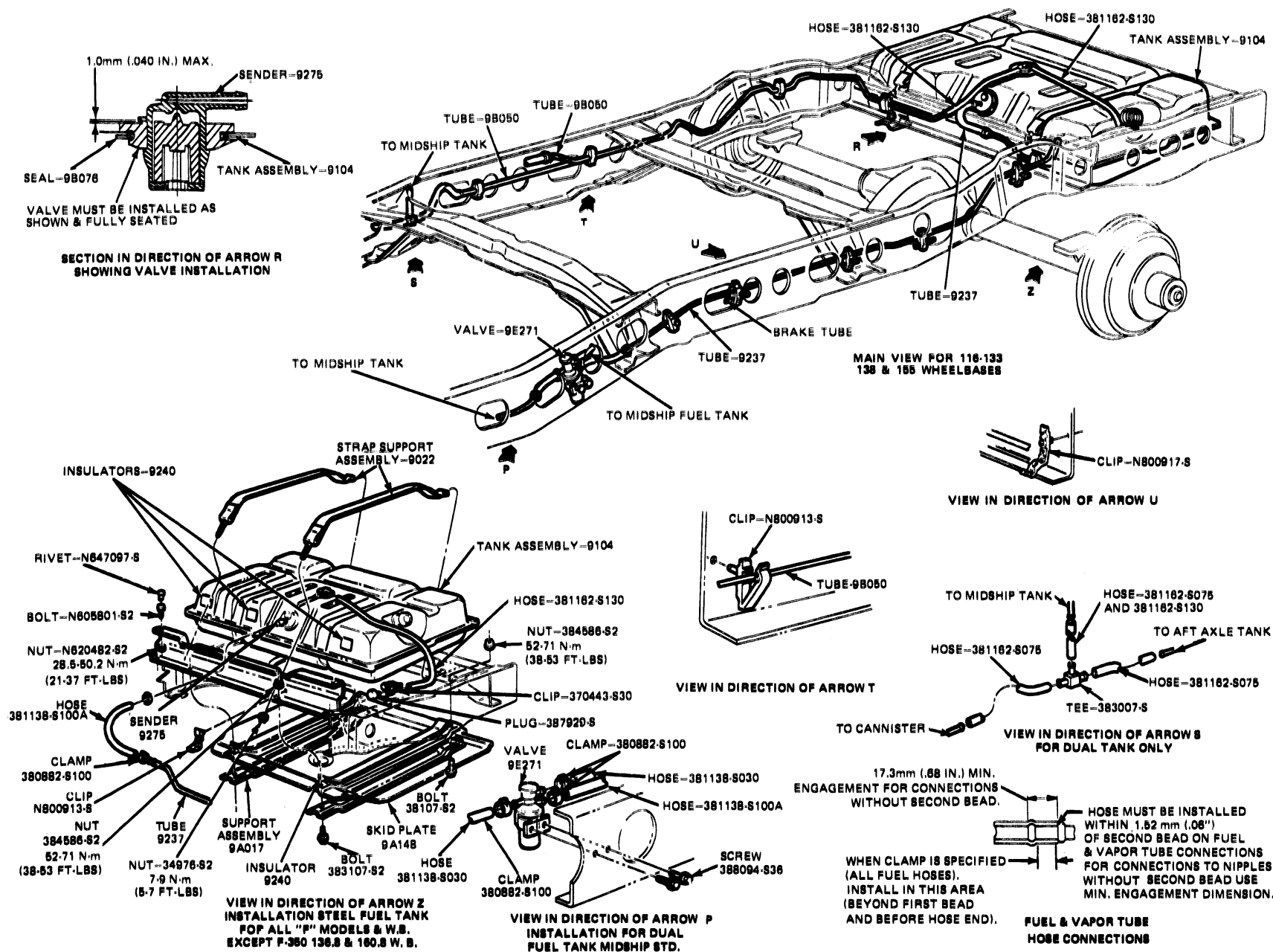
The filler cap used with vapor emission control systems and E-350 and F-350 vehicles has a pressure-vacuum valve that vents air into the tank as fuel is consumed to prevent tank collapse. Fuel vapor cannot vent to the outside atmosphere unless a pressure of 2 psi (nominal) above atmosphere is reached.



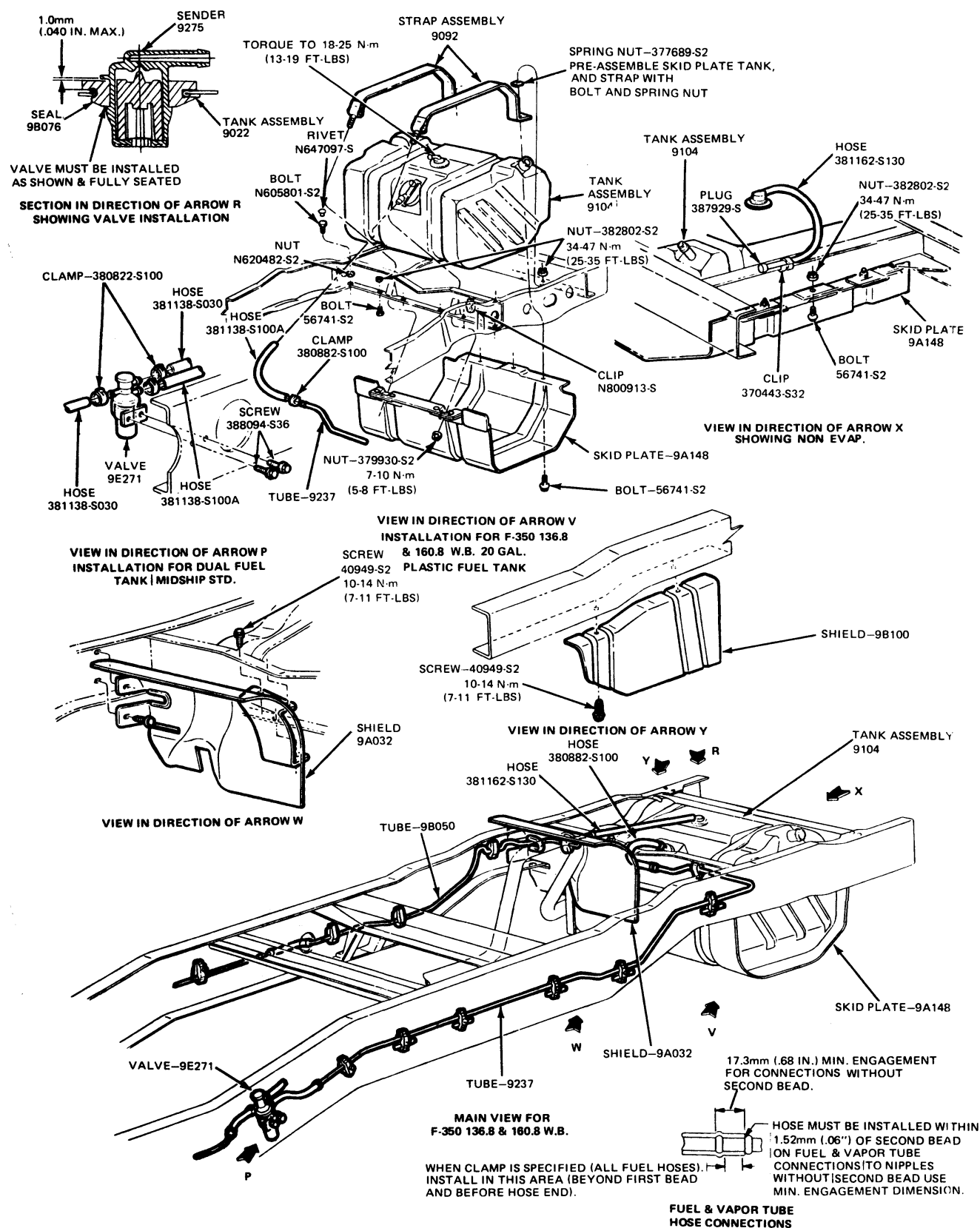
V2626-2A

FIG. 3 Bronco Fuel Tank Installation—25 and 32 Gallon Tank

FIG. 4 F-100—F-350 116, 133, 138 and 155 Inch Wheelbase Fuel Tank Installation

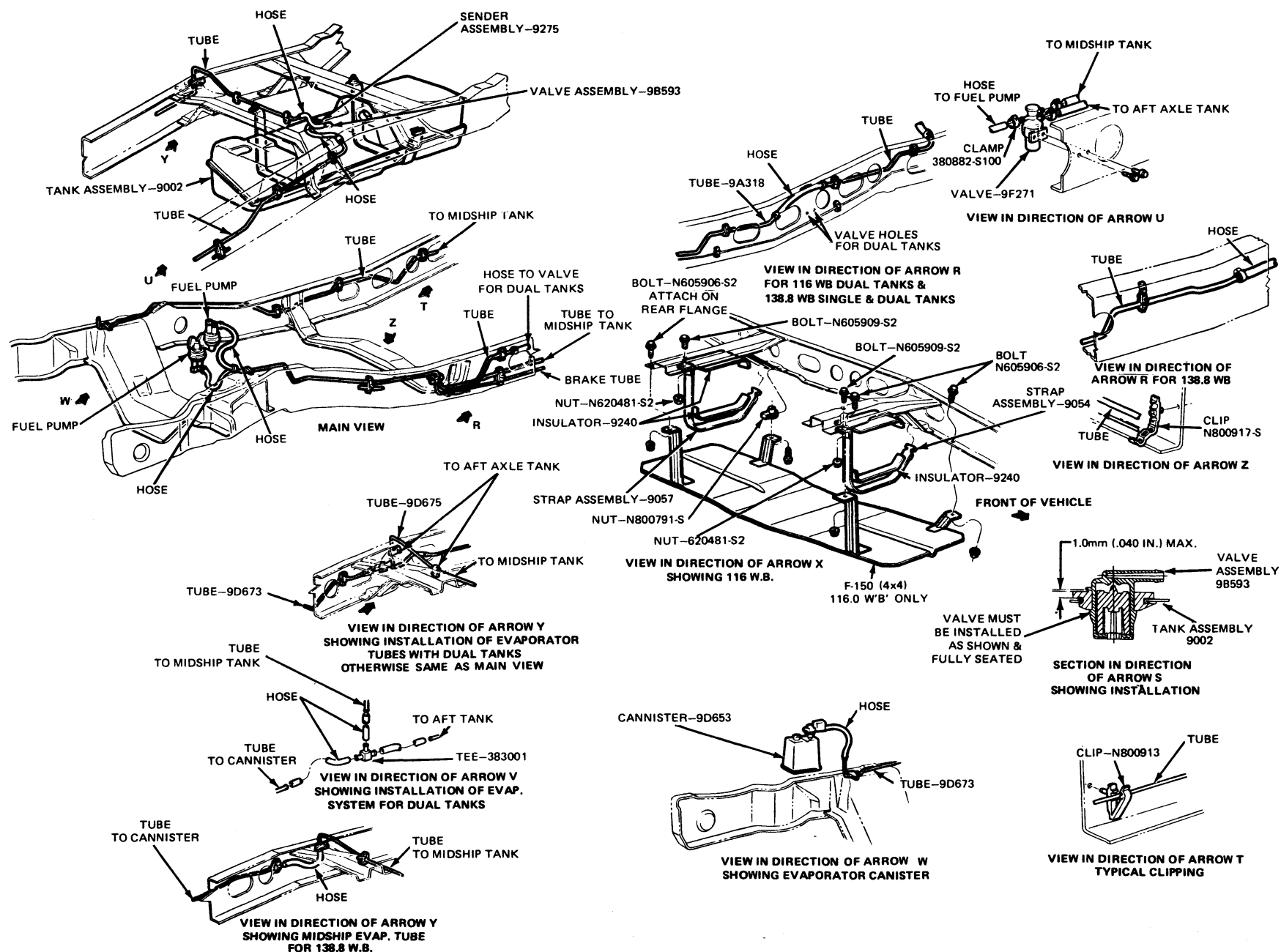


V2627-2A



V2628-2A

FIG. 5 F-350—136.8 and 160.8 Inch Wheelbase Fuel Tank Installation



V2629-2A

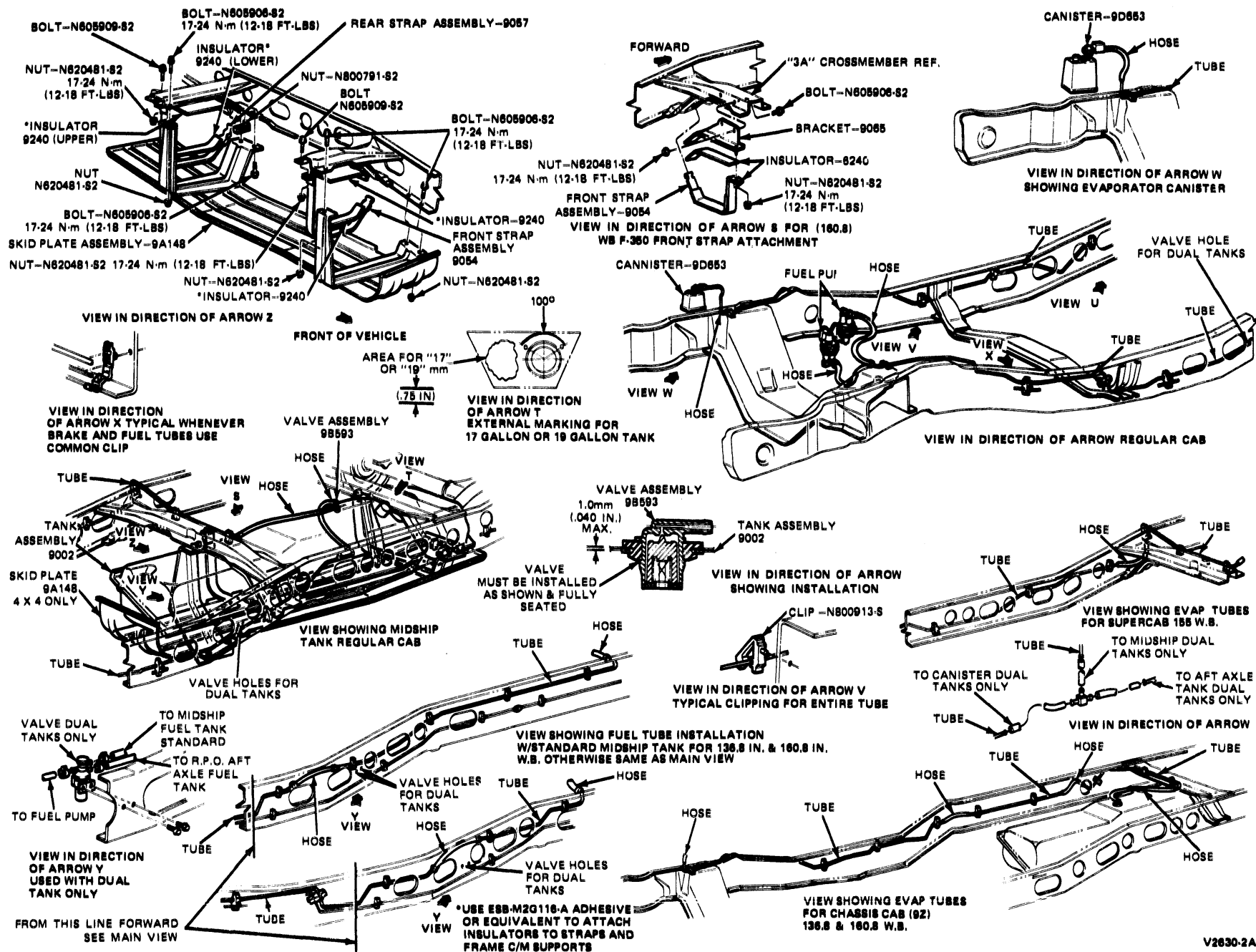
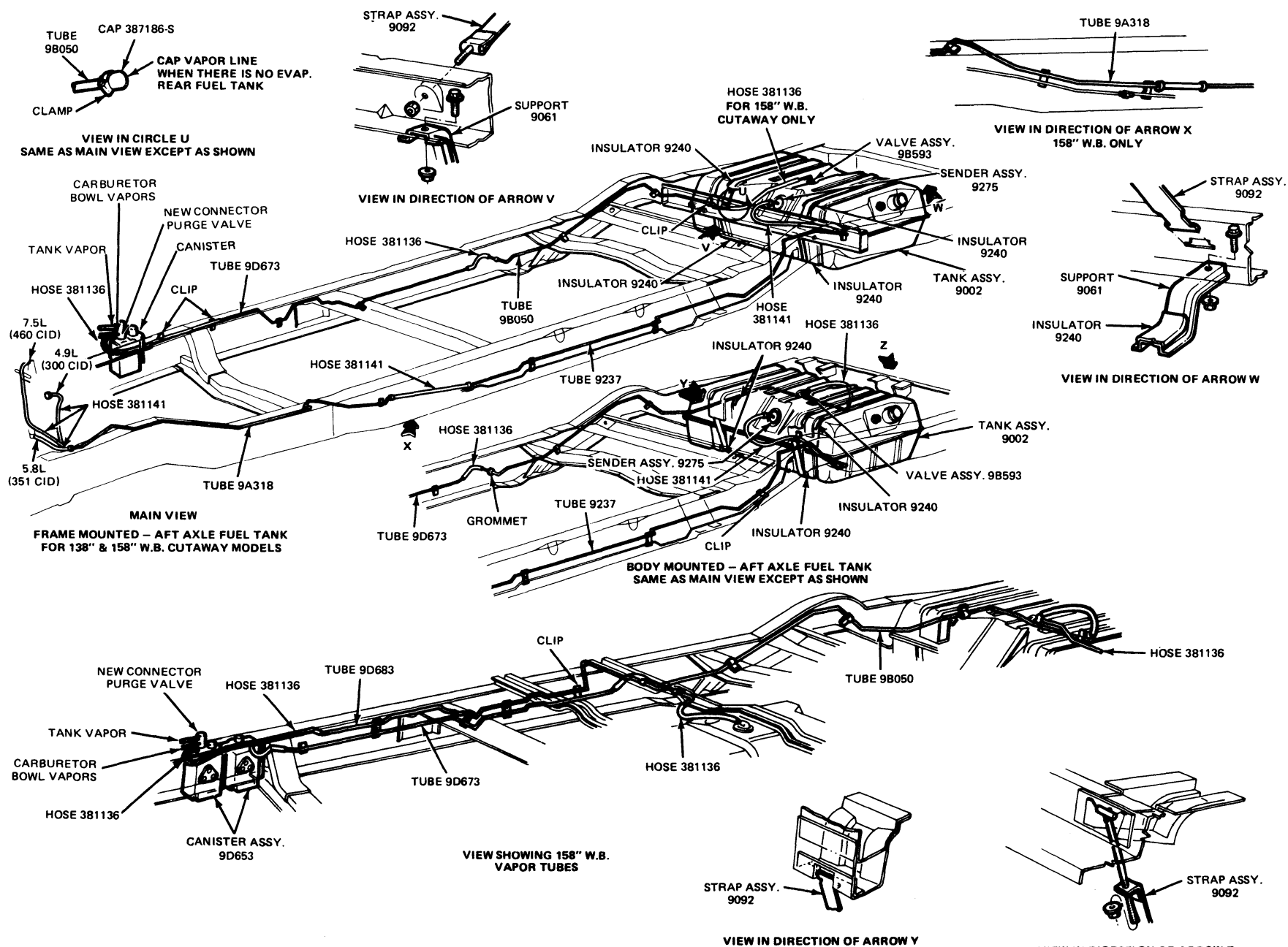


FIG. 7 F-100-F-350 Fuel System



V2358-28

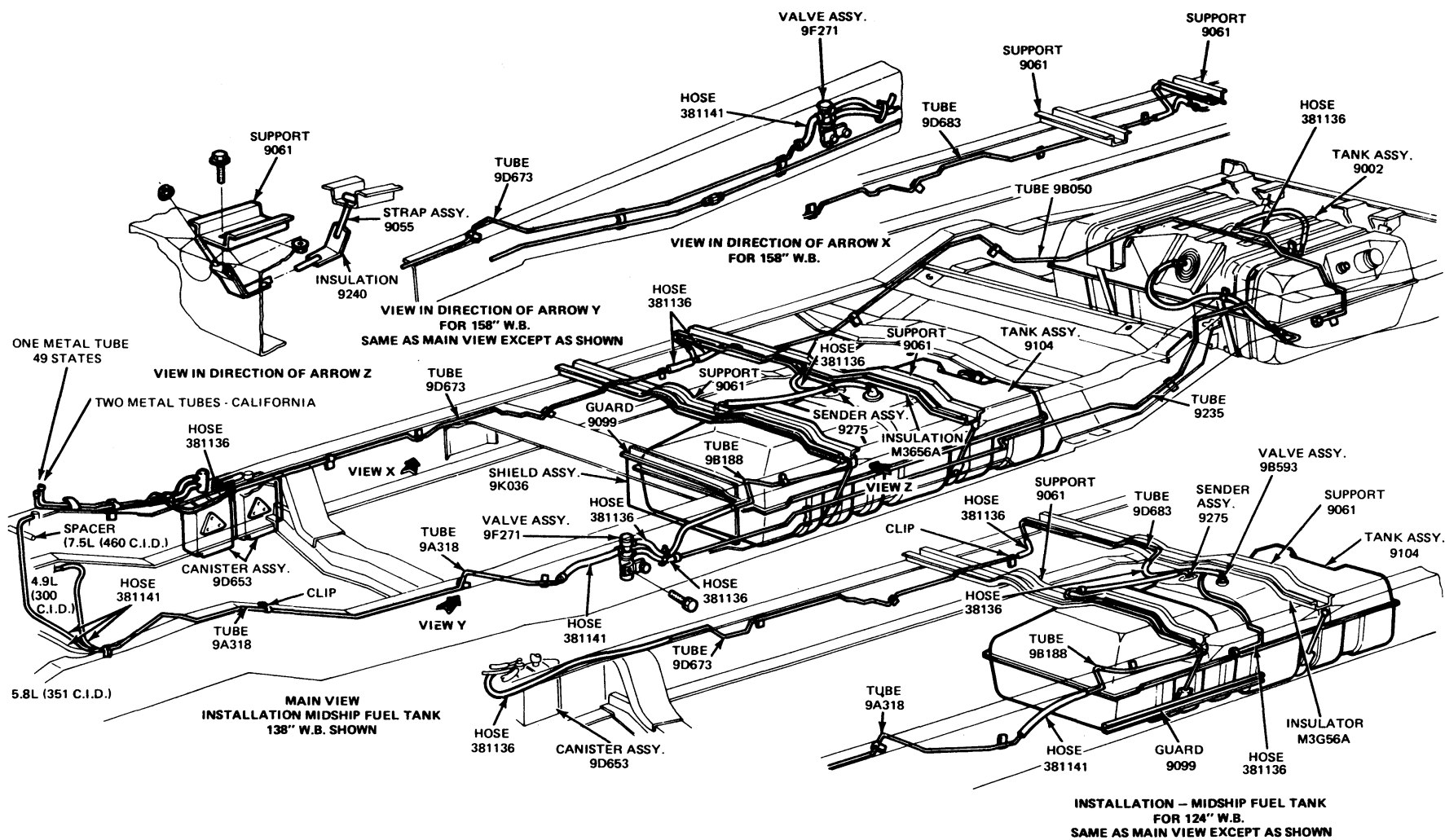
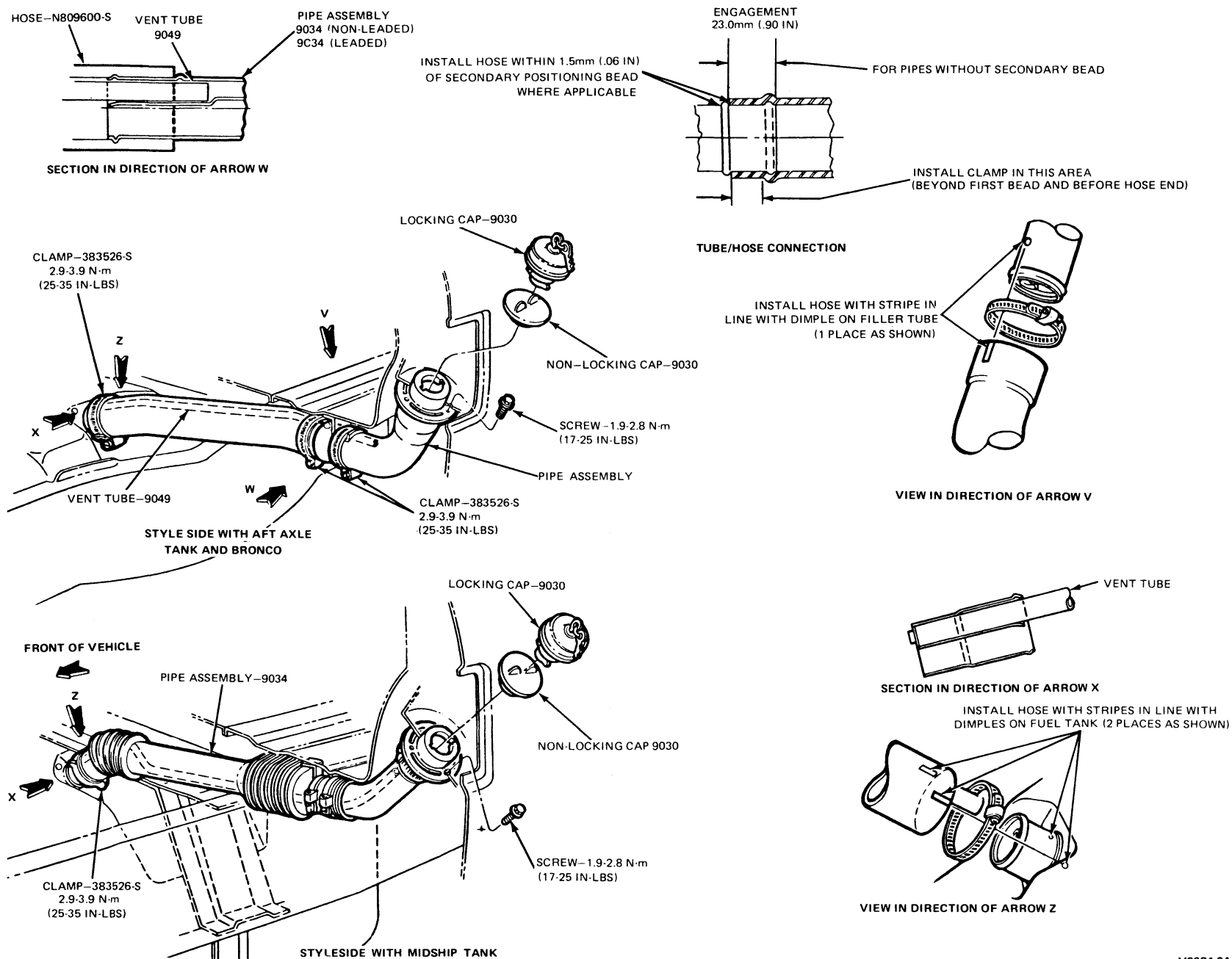


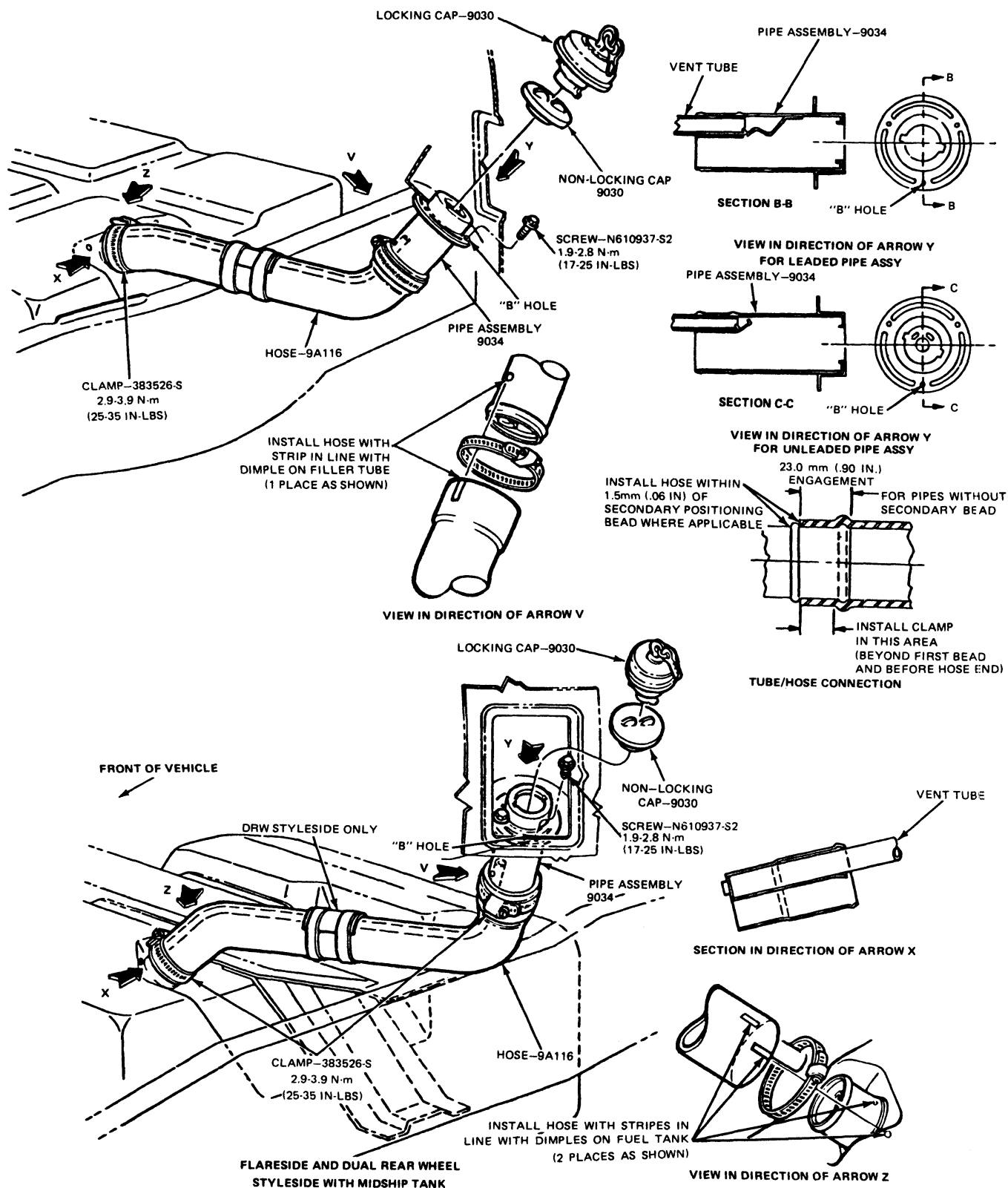
FIG. 9 Midship Fuel System Installation—E-100—E-350

V2381-28



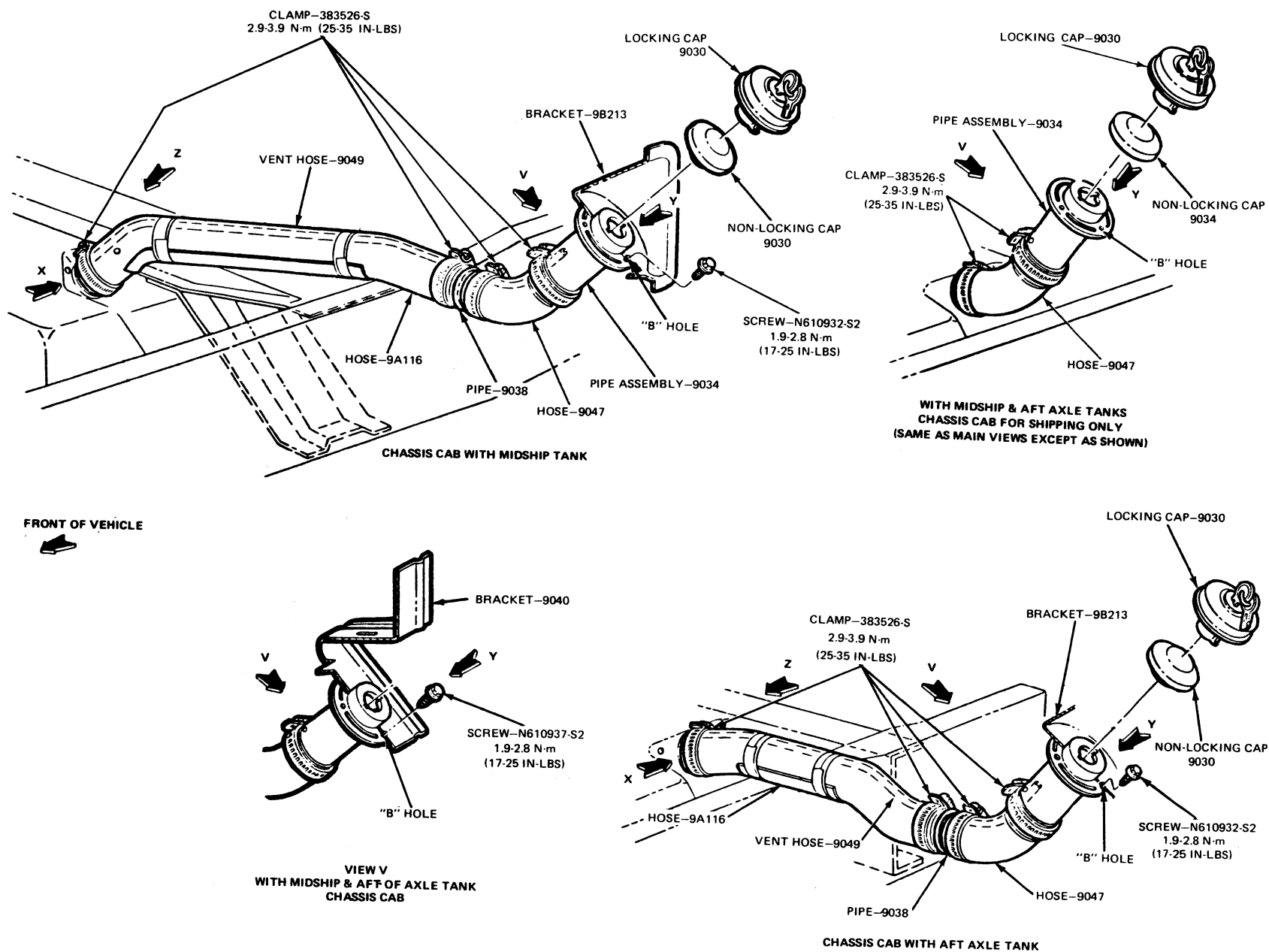
V2631-2A

FIG. 10 Fuel Filler System Installation—Single Rear Wheel Styleside F-100—350 and Bronco



V2632-2A

FIG. 11 Fuel Filler System Installation—Flairside and Dual Rear Wheel Styleside—F-100—F-350



V2633-2A

FIG. 12 Fuel Filler System Installation—F-Series Chassis Cab

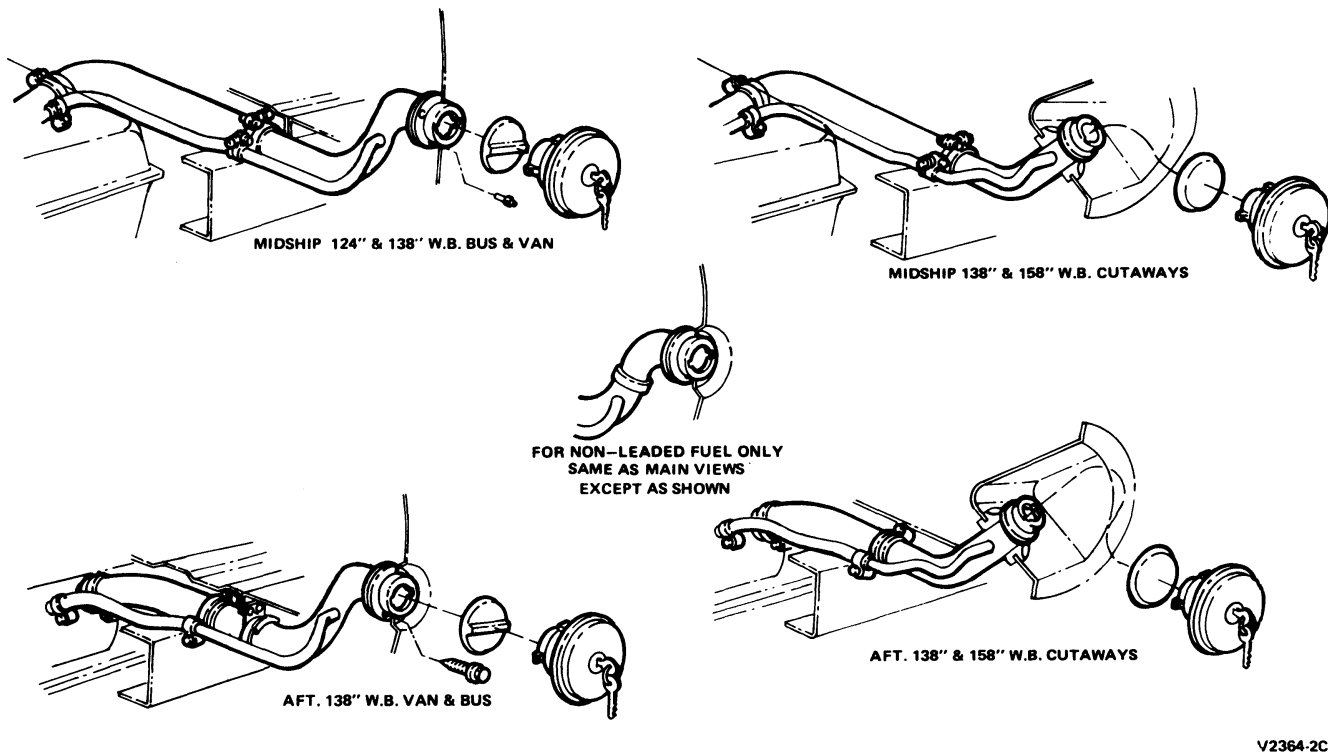


FIG. 13 Fuel Filler System Installation—E-100—E-350 (Midship and Aft Tank)

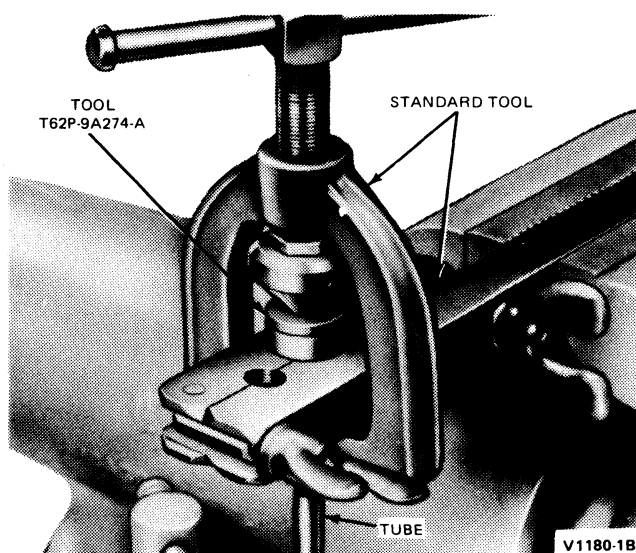


FIG. 14 Fuel Line Tube Die

The filler cap used on all vehicles except E-350 and F-350 (49 states) which use the same filler cap as evaporative emission control system equipped vehicles without vapor emission control incorporate an anti-surge mechanism that prevents fuel spillage through the cap due to surge when cornering. Atmospheric air and fuel vapor are normally free to pass in and out of the fuel system preventing tank collapse and/or excess pressure build up. In certain instances the anti-surge mechanism can prevent fuel vapor from passing through the cap, however pressure cannot build in excess of 2 psi (nominal) above atmospheric.

NOTE: Use of an after-market fuel filler cap other than an authorized Ford/Motorcraft service Part could result in damage to the fuel system or improper system operation if not properly designed/manufactured for pressure and vacuum relief. Customer warranty is void for fuel tank and/or fuel system damage resulting from the use of such caps.

ORIFICE VALVE

An orifice valve is located in the top of the tank. The restricted size of the orifice (0.050) tends to meter the amount of vapor and restricts fuel from passing out of the tank. The orifice valve connects into the vent line that runs forward to the carbon-filled storage canister in the engine compartment. Some orifice valves have a float system to further reduce the chance of liquid fuel passing into the vent line.

CARBON CANISTER

The carbon-filled canister acts as a storage system for the fuel vapors vented from the tank and from the carburetor. The hose leading to the canister is "ICE'D" to the PCV valve or carburetor spacer so that the stored vapors can be drawn into the engine and burned.

CALIFORNIA FUEL SYSTEM—GASOLINE ENGINES

All 6-cylinder vehicles with dual tanks and all vehicles with V-8 engines have two carbon canisters.

GASOLINE OCTANE RATING

Vehicles equipped with catalytic converters must use **UNLEADED GASOLINE ONLY** (as specified on the fuel gauge or adjacent to the fuel filler opening). Leaded

gasoline can damage the catalytic converter and affects other emission components. Non-catalyst vehicles are designed to operate on leaded, low lead, or unleaded gasoline. When the engine is adjusted to recommended specifications, you may use a gasoline with a minimum octane rating as designated by any of the following numbers:

Research Octane Number (RON) ..91

Average of Research Octane Number and Motor Octane Number

(Antiknock Index)87

Octane rating and unleaded gasoline availability may vary between gasoline stations. If you plan to drive your vehicle outside the United States, check the availability of gasoline of the correct type and rating in the area you expect to visit. Gasoline pumps with the symbol shown in Fig. 1 meet the octane requirements of all gasoline engines used in current model trucks.

FUEL TANK FILLING

The filler tube openings for the fuel tanks on trucks under 8500 pounds GVW have been made smaller to prevent accidental filling with other than unleaded fuel. Gasoline pumps in the United States dispensing unleaded fuel are equipped with nozzles to accommodate the smaller filler opening on the fuel tank.

Expansion of fuel due to temperature increases, or overfilling ("Topping Off") causes fuel overflow at the filler cap when the vehicle is standing or the cap is removed. To minimize this condition, it is recommended that the amount of fuel put in the tank when filling be limited to the automatic pump shutoff. If vehicle has two tanks, use fuel from both tanks after fill-up to reduce fuel levels.

FUEL TANK DRAINING

Use appropriate adapter to connect Rotunda suction pump 34-0062 or similar suction pump, to the fuel hose (at the fuel pump to fuel tube connection) and drain the fuel tank.

FUEL SELECTOR VALVE

The electrically actuated fuel tank selector valve in the de-energized state feeds the fuel pump from the front tank on F-Series and rear tank on E-series vehicles. When activated by a minimum of 9.5 volts through the tank selector switch, the fuel feed transfers to the rear tank on F-series and front tank on E-series vehicles. For the following diagnostic procedure both tanks must contain some usable fuel.

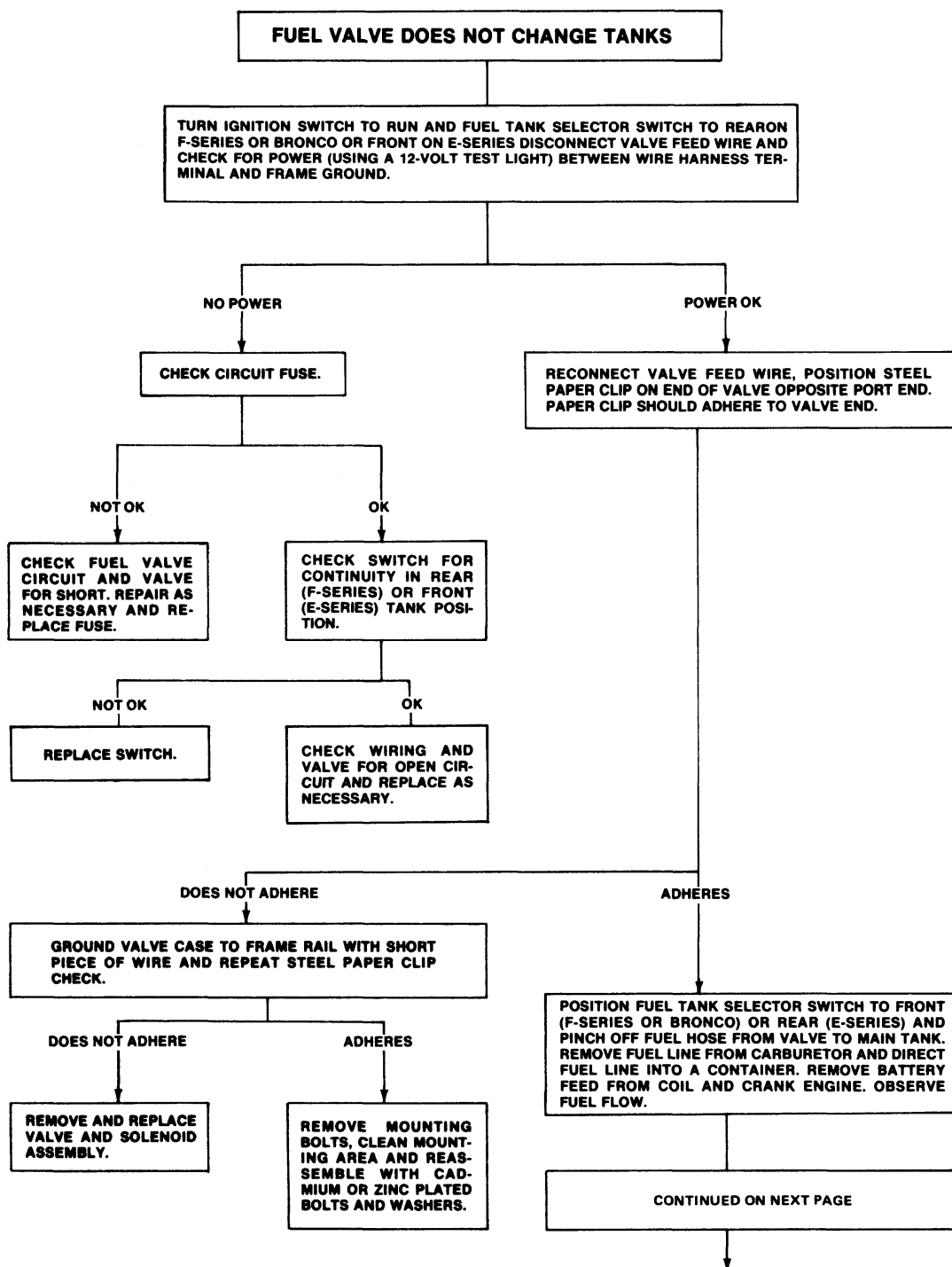
FUEL AND VAPOR HOSES

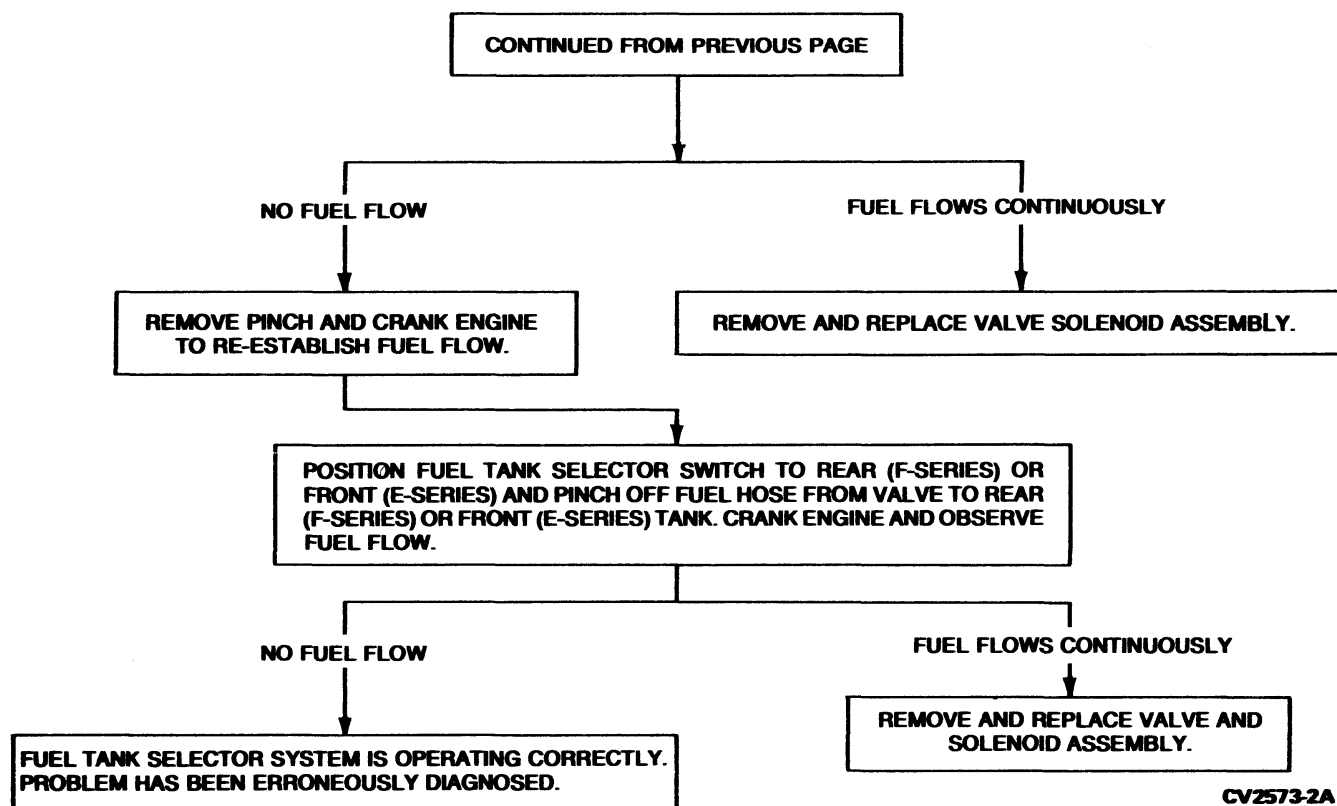
Fuel and vapor hoses should be assembled with the minimum engagement shown in Fig. 2.

DIAGNOSIS AND TESTING

DIAGNOSIS GUIDE

Refer to the following charts as a guide for diagnosis of fuel valve problems.





REMOVAL AND INSTALLATION

MIDSHIP FUEL TANK—F-100—F-350

Typical fuel tank installations are shown in Figs. 4 through 7. Refer to the specifications for the capacities and usage.

Removal

1. Drain the fuel into a suitable container by siphoning through the fuel hose at the fuel pump-to-fuel tube connection.
2. To avoid electrical sparking at the tank, disconnect the ground cable on the battery. Then disconnect the fuel gauge sending unit wire at the fuel tank.
3. On vehicles with dual tanks, disconnect ground wire after draining both tanks. Remove the clamps and disconnect the hoses attached to the fuel tank. On a vehicle equipped with a fuel evaporative emission control system, disconnect the vapor line from the emission control valve.
4. Remove the nuts and bolts from the retaining straps, and lower tank to floor. Replace any worn or damaged parts.

Installation

1. Position retaining straps around fuel tank and attach bolts and nuts. Tighten to specifications.
2. Connect the hoses to the tank and tighten the clamps to specifications. On a vehicle equipped with a fuel evaporative emission control system connect the vapor lines to the emission control valve located in the top of the tank.
3. Fill tank with fuel connect the battery ground cable, start the engine and check for leaks.

AFT-OF-AXLE FUEL TANK—F-100—F-350

Fuel tank installations are shown in Figs. 4 thru 7.

Removal

1. Raise the rear of the vehicle.
2. To avoid electrical sparking at the tank, disconnect the ground cable on the battery. Then disconnect the fuel gauge sending unit wire at the fuel tank.
3. On vehicles with dual tanks, disconnect the ground wire after both tanks have been drained. Siphon the fuel from the tank into a suitable container at the hose between the fuel pump and the fuel tube.
4. Loosen the fuel line hose clamps, slide the clamps forward and disconnect the fuel line at the fuel gauge sending unit.
5. If the fuel gauge sending unit is to be removed, turn the unit retaining ring counterclockwise and remove the sending unit, retaining ring and gasket.
6. Loosen the clamps on the fuel filler pipe as necessary and disconnect the filler pipe hose and vent hose from the tank.
7. If removing the metal type tank, support the tank and remove the bolts attaching the tank supports to the frame. Carefully lower the tank and disconnect the vent tube from the vapor emission control valve in the top of the tank. Finish removing the filler pipe and filler pipe vent hose if not possible in Step 6. Remove the tank from under the vehicle.
8. If removing the plastic type tank, support the tank and remove the bolts attaching the combination

skid plate and tank support to the frame. Carefully lower the tank and disconnect the vent tube from the vapor emission control valve in the top of the tank. Complete removing the filler pipe if not possible in Step 6. Remove the skid plate and tank from under the vehicle. Disassemble the skid plate from the tank.

Installation

1. If the tank or vapor emission control valve is being replaced, follow the installation instructions in Figs. 4 through 7. Install new support strap insulation as required.
2. If installing the plastic type tank, preassemble the skid plate to the tank as shown in Figs. 4 and 5.
3. Raise the tank and attach the vent hose to the vapor emission control valve.
4. Start the tank neck into the hose.
5. Position the tank assembly against the top straps or the frame and install the attaching bolts and nuts. Tighten the attaching bolts and nuts to specifications.
6. Connect the filler pipe hose and tighten the clamps to specifications.
7. If the fuel gauge sending unit was removed, make sure all the old gasket material has been removed from the unit mounting surface on the tank. Using a new gasket, position the fuel gauge sending unit to the fuel tank and secure with the retaining ring.
8. Connect the fuel gauge sending unit wire to the sending unit.
9. Connect the fuel line at the fuel gauge sending unit and tighten the clamps securely. Install the drain plug, if so equipped.
10. Connect the vehicle battery ground cable removed in Step 2—Removal.
11. Fill the tank and check all connections for leaks.
12. Lower the vehicle.

FUEL TANKS

E-100, E-350

The E-100—E-350 fuel tank installations are shown in Figs. 8 and 9.

AFT AXLE BODY MOUNTED TANKS

Removal

1. Insert a siphon through the fuel filler pipe assembly and drain the fuel into a suitable container.
2. Raise the rear of the vehicle.
3. To avoid electrical sparking at the tank, disconnect the ground cable on the vehicle battery. Then disconnect the fuel gauge sending unit wire at the fuel tank.
4. Loosen the clamps on the fuel filler hose at the tank neck. Disconnect the hoses from the tank.
5. Loosen the fuel line hose clamp and disconnect the fuel line hose from the fuel gauge sending unit.
6. Support the tank in position. Remove the nuts that attach the mounting straps to the "T" bolts (**Note: The "T" bolts are attached to body brackets located at the rear of the tank**). Disengage the

straps from the J-bolts and the front body brackets and lower the tank enough to gain access to the vapor valve. (All vehicles with evaporative emissions systems will be equipped with emission control valves).

7. Disconnect the vapor hose from the vapor control valve.
8. Lower the fuel tank and remove it from underneath the vehicle.
9. If the fuel gauge sending unit is to be removed, turn the unit retaining ring counterclockwise and remove the sending unit retaining ring and gasket.
10. If the vapor control valve is to be removed, pull it out of the grommet located in the top of the tank and remove the grommet.

Installation

1. If the fuel gauge sending unit was removed, scrape away the old gasket material from the unit mounting surface on the fuel tank. Using a new gasket, position the fuel gauge sending unit to the fuel tank and secure with the retaining ring.
2. If the vapor control valve was removed, install the grommet in the tank opening and press-fit the valve into place.
3. If the insulator pads were worn or damaged, remove the material and install new pads.
4. Attach the front ends of the mounting straps to the front body brackets.
5. Raise the tank high enough and connect the vapor hose to the vapor valve.
6. Secure the strap ends to the J-bolts with the attaching nuts. Tighten nuts to specifications.
7. Connect the fuel line hose to the fuel gauge sending unit.
8. Connect the fuel filler hose to the filler neck and vent neck at the tank. Tighten hose clamps to specifications.
9. Connect the vehicle battery ground cable removed in Step 2 of the removal procedure. Connect the fuel gauge sending unit wire.
10. Fill the tank and check all connections for leaks.

AFT AXLE FRAME MOUNTED TANK

Removal

1. Insert a siphon through the fuel filler pipe assembly and drain the fuel into a suitable container.
2. Raise the rear of the vehicle.
3. To avoid electrical sparking at the tank, disconnect the ground cable on the vehicle battery. Then disconnect the fuel gauge sending unit wire at the fuel tank.
4. Loosen the clamps on the fuel filler hose at the tank neck. Disconnect the hoses from the tank.
5. Loosen the fuel line hose clamp and disconnect the fuel line hose from the fuel gauge sending unit.
6. Support the tank in position. Remove the nuts and bolts that attach the tank supports to the frame. Disengage the straps from the front tank support and the rear crossmember and lower the tank enough to gain access to the vapor valve. (All

vehicles with evaporative emission systems will be equipped with vapor emission valves).

7. Disconnect the vapor hose from the vapor control valve.
8. Lower the fuel tank and remove it from underneath the vehicle.
9. If the fuel gauge sending unit is to be removed from the unit, turn the unit retaining ring counterclockwise and remove the sending unit, retaining ring and gasket.
10. If the vapor control valve is to be removed, pull it out of the grommet located in the top of the tank, and remove the grommet.

Installation

1. If the fuel gauge sending unit was removed, scrape away all the old gasket material from the unit mounting surfaces on the fuel tank. Using a new gasket, position the fuel gauge sending unit to the fuel tank and secure with the retaining ring.
2. If the evaporative valve was removed, install the grommet in the tank opening and press-fit the valve into place.
3. If the insulation pads were worn or damaged, remove the material and install new pads.
4. Attach the mounting straps to the rear crossmember. Raise the tank high enough and connect the vapor hose to the vapor valve.
5. Position the tank assembly against the top straps and install the support and attaching bolts and nuts. Tighten the nuts to 34-46 N.m (25-34 ft-lbs).
6. Connect the fuel filler hose to the filler neck at the tank. Tighten the hose clamps.
7. Connect the vehicle battery ground cable removed in Step 3 of the removal procedure. Connect the fuel gauge sending unit wire.
8. Fill the tank and check all connections for leaks.

MIDSHIP TANK

Removal

1. Insert a siphon through the fuel filler pipe assembly and drain the fuel into a suitable container.
2. Raise the vehicle.
3. To avoid electrical sparking at the tank, disconnect the ground strap on the vehicle battery. Then disconnect the fuel gauge sending unit wire at the fuel tank.
4. Support the tank in position. Disengage the mounting strap ends attached to the frame side rail. Remove the other end from the tank support by rotating the strap to disengage the "T" shaped hook end.
5. Lower the tank enough to gain access to the vapor valve, fuel filler hose, fuel vent hose, and fuel line hose. Loosen the attaching clamps and disconnect the hoses.
6. Lower the tank and remove it from underneath the vehicle.
7. If the fuel gauge sending unit is to be removed, turn the retaining ring counterclockwise and remove the sending unit, retaining ring and gasket.

8. If the vapor control valve is to be removed, turn the unit retaining ring counterclockwise and remove the vapor valve, retaining ring and gasket.

Installation

1. If the fuel gauge sending unit was removed, scrape away all the old gasket material from the unit mounting surface on the fuel tank. Using a new gasket, position the fuel gauge sending unit to the fuel tank and secure with the retaining ring.
2. If the vapor valve was removed, install the valve in the tank opening, following the procedure described for the fuel gauge sending unit installation.
3. If the insulation tape was worn or damaged, remove the material and install new pieces approximately 16.5 inches long, (two pieces).
4. Attach the "T" hook mounting strap ends in the tank supports. Raise the tank high enough and connect the vapor hose, fuel filler hose, fuel vent hose, and fuel line hose. Tighten the clamps that attach the hoses to the mating tank parts.
5. Attach the mounting straps stud end to the frame side rail with attaching nuts and tighten to specifications.
6. Connect the vehicle battery ground cable removed in Step 3 of the removal procedure. Connect the fuel gauge sending unit wire.
7. Fill the tank and check all connections for leaks.

FUEL TANK

BRONCO

The Bronco fuel tank is shown in Fig. 3.

Removal

1. Drain the fuel into a suitable container at the fuel hose between the fuel pump and fuel tube.
2. Raise the rear of the vehicle.
3. To avoid electrical sparking at the tank, disconnect the ground cable on the vehicle battery.
4. Loosen the clamp on the fuel filler pipe hose at the filler pipe and disconnect the hose from the pipe.
5. Loosen the hose clamps, slide the clamps forward and disconnect the fuel line at the fuel gauge sending unit.
6. Support the tank and remove the lower support bracket bolts or skid plate bolts. Remove the support assembly or skid plate attaching nut at each tank mounting strap, lower the support assemblies, and lower the tank enough to gain access to the tank vent hose.
7. Disconnect the fuel gauge sending unit wire at the fuel tank.
8. Disconnect the fuel tank vent hose at the top of the tank.
9. Disconnect the fuel tank to vapor separator lines at the fuel tank.
10. Remove the fuel tank from under the vehicle.

If the fuel gauge sending unit is to be removed, turn the unit retaining ring. Remove sending unit and gasket.

Installation

1. If the fuel gauge sending unit was removed, make sure all the old gasket material has been removed from the mounting surface on the fuel tank. Using a new gasket, position the fuel gauge sending unit to the fuel tank and secure with the retaining ring.
2. Position the forward edge of the tank and skid plate (if so equipped) to the frame crossmember, support the tank and connect the vent hose to the top of the tank. Connect the fuel tank to vapor separator tank lines at the fuel tank.
3. Connect the fuel gauge sending unit wire to the sending unit.
4. Position the tank and mounting support assemblies and straps, and install the attaching parts. Tighten to specifications.
5. Connect the fuel line at the fuel gauge sending unit and tighten the drain plug, if so equipped.
6. Connect the filler pipe-to-tank hose at the filler pipe and install the hose clamp.
7. Connect the vehicle battery ground cable removed in Step 3 of the above removal procedure.
8. Fill the tank and check all connections for leaks.
9. Lower the vehicle.

FILLER PIPE IN-FRAME FUEL TANKS

Procedures are the same for the aft axle and midship fuel filler pipe (Figs. 10 through 13).

F-100—F-350, BRONCO AND E-SERIES CUTAWAY AND PDV**Removal**

1. Drain fuel to a level (approximately three-fourths full) below the fuel tank filler connection by using the fuel hose at the fuel pump to fuel tube connection.
2. Loosen clamps attaching filler pipe to fuel filler and vent hoses.
3. Detach fuel filler pipe from support bracket and disconnect fuel filler and vent hoses.
4. Remove fuel filler pipe from vehicle.
5. Remove hose and clamps. Replace all damaged or worn parts.

Installation

1. Position fuel filler pipe in vehicle.
2. Position clamps and fuel filler vent hoses on filler pipe.
3. Secure fuel filler pipe to mounting brackets.
4. Adjust hose to obtain snug filler pipe installation and tighten hose clamps. Make certain clamps are forward of flange on filler pipe to ensure a leakproof connection. If removed, install drain plug.
5. Fill tank with fuel. Install filler cap; check for leaks.

FILLER PIPES**E-100—E-350 VANS AND CLUB WAGONS**

The procedures are the same for the aft axle and midship filler pipe assembly (Fig. 13).

Removal

1. Insert a siphon through the fuel filler pipe assembly and drain the fuel to a level below the filler pipe.
2. Remove the three retainer screws that attach the filler pipe flange to the body fuel filler pipe housing.
3. Loosen the clamps that attach the filler pipe to the fuel filler hose and the fuel vent hose. Disconnect the hoses.
4. Loosen the clamp that attaches the filler pipe to the support bracket at the underbody flange (Aft/Axle Only).
5. Remove the fuel filler pipe assembly by rotating it through the opening in the underbody below the body housing assembly.

Installation

1. Install the fuel filler pipe assembly by inserting it through the underbody opening and rotating it to butt the pipe flange against the body side panel.
2. Attach the pipe flanges to the body side panel with three retaining screws. Tighten screws to specifications.
3. Tighten the clamps that attach the filler pipe to the support bracket at the underbody flange (Aft/Axle Only).
4. Connect the fuel filler hose and the fuel vent hose to the fuel filler assembly. Tighten the attaching clamps.
5. Fill the tank, install fuel filler cap and check all connections for leaks.

FUEL LINES—METAL

The various fuel lines are not serviced as assemblies. They must be cut, squared, and formed out of fuel system tubing and hose material available at dealerships.

A damaged section of tubing longer than 12 inches can be cut out of the existing line and replaced by service hose and two retaining clamps. All replacement hoses must be cut to a length that will ensure proper clamp retention beyond the ends of the connecting tubing.

Removal

1. Disconnect the fuel line(s) at both ends and remove the unit(s) from the holding clip(s), and the truck.
2. Slide the loom(s) (if used) off the line(s). Replace all worn or damaged parts.

Installation

1. Use the same diameter tubing as the original installation(s), and shape the new line(s) to the contour of the original line(s). Avoid sharp bends.
2. Cut the new line(s) to approximately the same length as the original line(s). Allow an additional length for the flaring operation.
3. Square off the ends with a file, and ream the sharp edges with the reamer blade on the tube cutter.
4. Position the new loom(s) (if used) on the new line(s). Place new connections on the line, if required, and flare the ends of the line(s) with a flaring tool (Fig. 32). When attaching new line to fuel pump or any

- other fitting, be sure to use a double lap flare in the line. Be sure metal chips are removed from inside the tubing.
5. Install the connecting hoses and clamps, (if required), on the fuel line(s). Position the line(s) in the clip(s) on the vehicle, and tighten the connection(s). Tighten the connecting hose clamps, if so equipped.
 6. Check the connection for leaks.

SELECTOR VALVE—AUXILIARY FUEL TANK

F-100-350 AND E-100—E-350

Removal

1. Remove the fuel hoses from the valve.

2. Remove electrical connector.
3. Remove (1) nut and (1) ground wire.
4. Remove the (2) bolt and washer assemblies mounting the selector valve (Figs. 4 through 9).

Installation

Reverse above procedure. **Note: Be sure to attach the ground wire. Make sure the specified mounting bolt and washer assemblies are used for installation as the solenoid is internally grounded.**

SPECIFICATIONS

STANDARD AND AUXILIARY FUEL TANKS (CAPACITY IN LITERS — GALLONS)

Model		Body Style	Location	Fuel Evap.	Advertised Tank Cap. Refill
Series	W.B. MM (In)				
E-100, 150 Van E-100, 150 Wagon	3150 (124)	All	Midship	X	18.0
E-100, 150, 250 350 Van E-150, 250 Wagon E-250, 350 Cutaway & Stripped Chassis ③ E-250, 350 PDV	3505 (138) 3505 (158)	All	Aft/Axle	X	22.1
E-150, 250, 350 Super Van, Super Wagon	3505 (138)	All	Aft/Axle	X	22.1
Bronco (4x4)	2660 (104.7)	All	Aft/Axle ① Aft/Axle ③④	X X	95 (25) 121 (32)
F-100 (4x2)	2967 (116.8)	Reg. Cab	Midship	X	64 (17)
			Aft/Axle ②	X	72 (19)
	3378 (133.0)	Reg. Cab	Midship	X	64 (17)
			Aft/Axle ②	X	72 (19)
F-150 (4x2) (4x4) (4x2) (4x4)	2967 (116.8)	Reg. Cab	Midship	X	64 (17)
			Aft/Axle ②	X	72 (19)
	3378 (133.0)	Reg. Cab	Midship	X	72 (19)
			Aft/Axle ②	X	72 (19)
	2967 (116.8)	Reg. Cab	Midship ①	X	64 (17)
			Aft/Axle ①②	X	72 (19)
	3378 (133.0)	Reg. Cab	Midship ①	X	72 (19)
			Aft/Axle ①②	X	72 (19)
	3526 (138.8)	Super Cab	Midship	X	64 (17)
			Aft/Axle ②	X	72 (19)
	3937 (155.0)	Super Cab	Midship	X	72 (19)
			Aft/Axle ②	X	72 (19)
F-250 (4x2) (4x4)	3378 (133.0)	Reg. Cab	Midship	X	72 (19)
			Aft/Axle ②	X	72 (19)
	3526 (138.8)	Super Cab	Midship	X	64 (17)
			Aft/Axle ②	X	72 (19)
	3937 (155.0)	Super Cab	Midship	X	72 (19)
			Aft/Axle ②	X	72 (19)
	3378 (133.0)	Reg. Cab	Midship ①	X	72 (19)
			Aft/Axle ①②	X	72 (19)
F-350 (4x2)	3378 (133.0)	Reg. Cab	Midship ①	X	72 (19)
			Aft/Axle ①②	X	72 (19)
	3475 (136.8)	Cab Chassis	Midship	X	72 (19)
			Aft/Axle ③④	X	72 (19)
	4084 (160.8)	Cab Chassis	Midship	X	72 (19)
			Aft/Axle ③④	X	72 (19)
	3937 (155.0)	Super Cab	Midship	X	72 (19)
			Aft/Axle ②	X	72 (19)

① W/R.P.O. Skid Plate

② Steel Auxiliary Tank

③ Plastic Auxiliary

④ Standard Skid Plate

⑤ 4 Gal. Throwaway Standard on RV Chassis/RT Cutaway, Commercial Cutaway, Commercial Chassis and PDV.

CV2366-2C

RPO TANKS — E-100—E-350

Model		Body Style	Location	Advertised Tank Cap. (Refill)
Series	W.B.			
E-100, 150, 250, 350 Van	138	All	Midship	18.0
E-150, 250 Wagon, E-350 ①	155			
E-350 Cutaway	138/155	All	Aft/Axle	40
E-150, 250, 350 Super Van/Wagon	138	All	Midship	18.0

① RV Cutaway, RV Chassis, Commercial Chassis, Commercial Stripped Chassis (Midship Tank Standard w/9550/9800 GVW)

CV2367-2C

Fuel Filters		PART 24-51	
APPLIES TO ALL MODELS			
SUBJECT	PAGE	SUBJECT	PAGE
DESCRIPTION	24-51-1	REMOVAL AND INSTALLATION In-Line Fuel Filter — Bronco, F-100 — F-350 and E-100 — E-350	24-51-2

DESCRIPTION

The fuel filters for mechanical fuel pumps are located on the carburetor.

Replace the in-line fuel filter assembly if clogged, and also at the recommended maintenance mileage interval.

Refer to the 1980 Truck Pre-Delivery, Maintenance and Lubrication Manual for the recommended maintenance mileage interval.

REMOVAL AND INSTALLATION

FUEL FILTER

ALL MODELS, ALL ENGINES

Removal

1. Remove the air cleaner.
2. Remove the spring-type clamp securing the inlet hose to the fuel filter line. If filter is located in line, loosen or remove outlet hose clamps also.
3. Unscrew the fuel filter from the carburetor on those models that are so equipped. Disconnect the fuel

filter hose from the metal line and discard the clamp, filter and hose.

Installation

1. Install new clamps on a new inlet hose and outlet hose if equipped and connect the hose to the filter and line. Thread the filter into the carburetor inlet port if so equipped. Tighten the filter.
2. Position and install spring type clamps.
3. Start the engine and check for fuel leaks.

Throttle Linkage

**PART
24-60****APPLIES TO ALL MODELS**

SUBJECT	PAGE	SUBJECT	PAGE
ADJUSTMENTS	24-60-1	REMOVAL AND INSTALLATION	24-60-1

ADJUSTMENTS

Instructions for adjusting throttle linkages used on all gasoline-engine trucks are contained in the following illustrations. Refer to the appropriate Figure for procedures.

Whenever possible, the engine should be at operating temperature when throttle linkage adjustments are made.

Be sure to re-install throttle return springs in the manner shown on the illustrations. After adjustment, the accelerator should return to idle on slow release of foot pressure, without binding or dragging.

REMOVAL AND INSTALLATION

Linkage disconnect points are shown in Figs. 1 through 4. Installation torques of major parts are also given.

Be sure to reinstall throttle return springs in the manner shown on the illustrations.

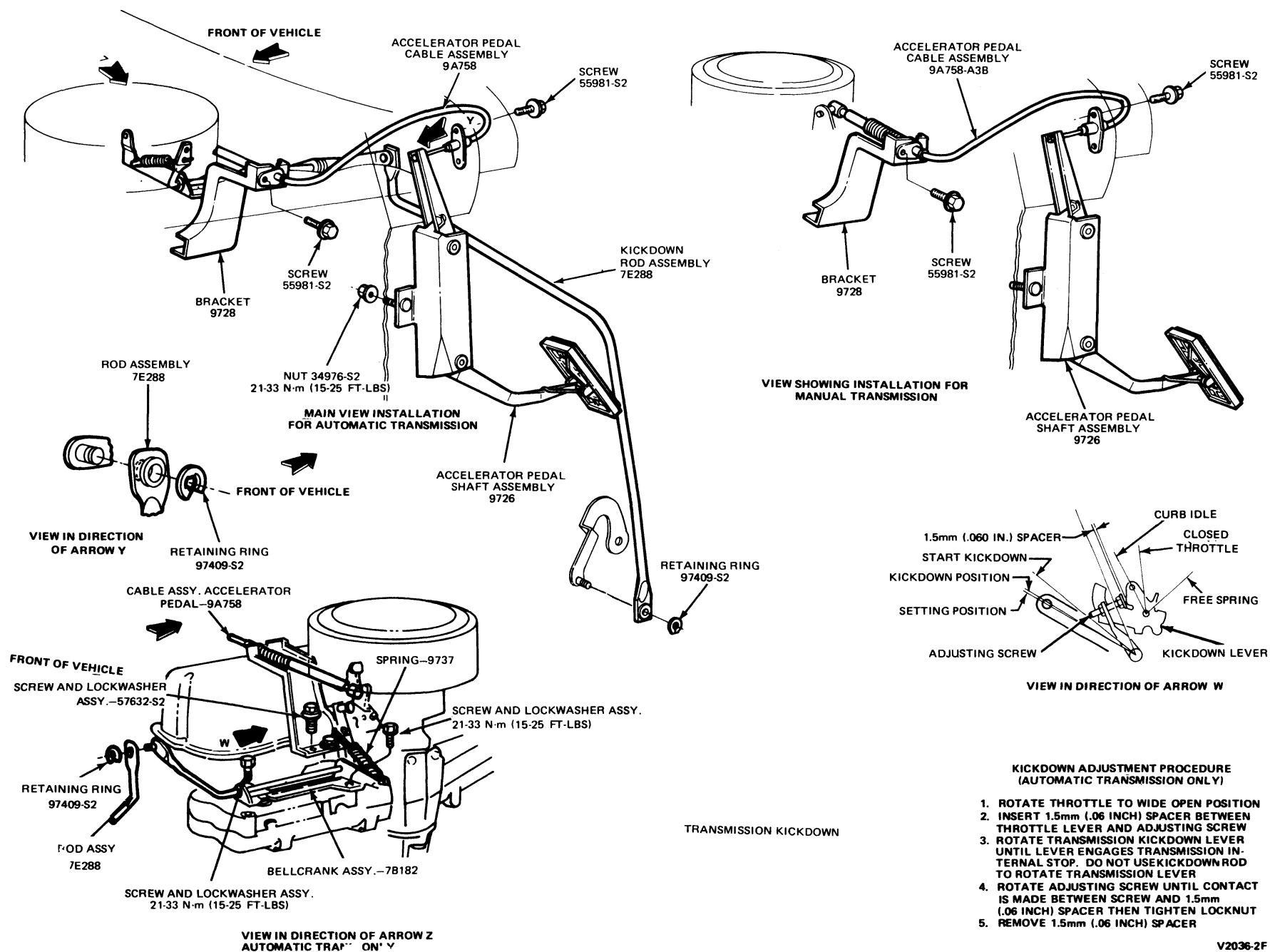
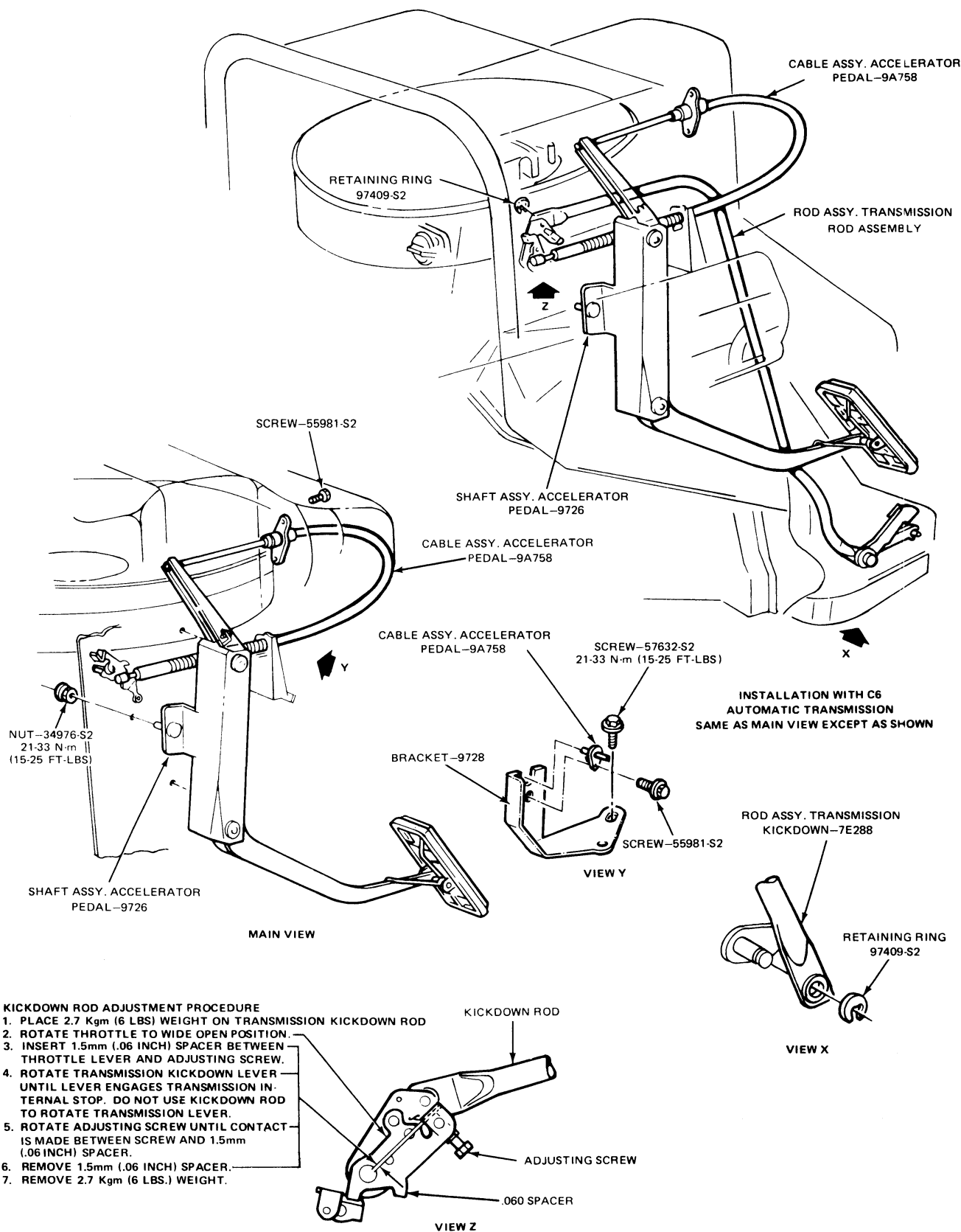


FIG. 1 Throttle Linkage—E-100—E-350 with 4.9L (300 CID) -6 Cyl. Engine



V2176-2D

FIG. 2 Throttle Linkage—E-100—E-350 with 5.0L (302 CID) V-8, 5.8L (351 CID) V-8 and 7.5L (460 CID) V-8 Engines

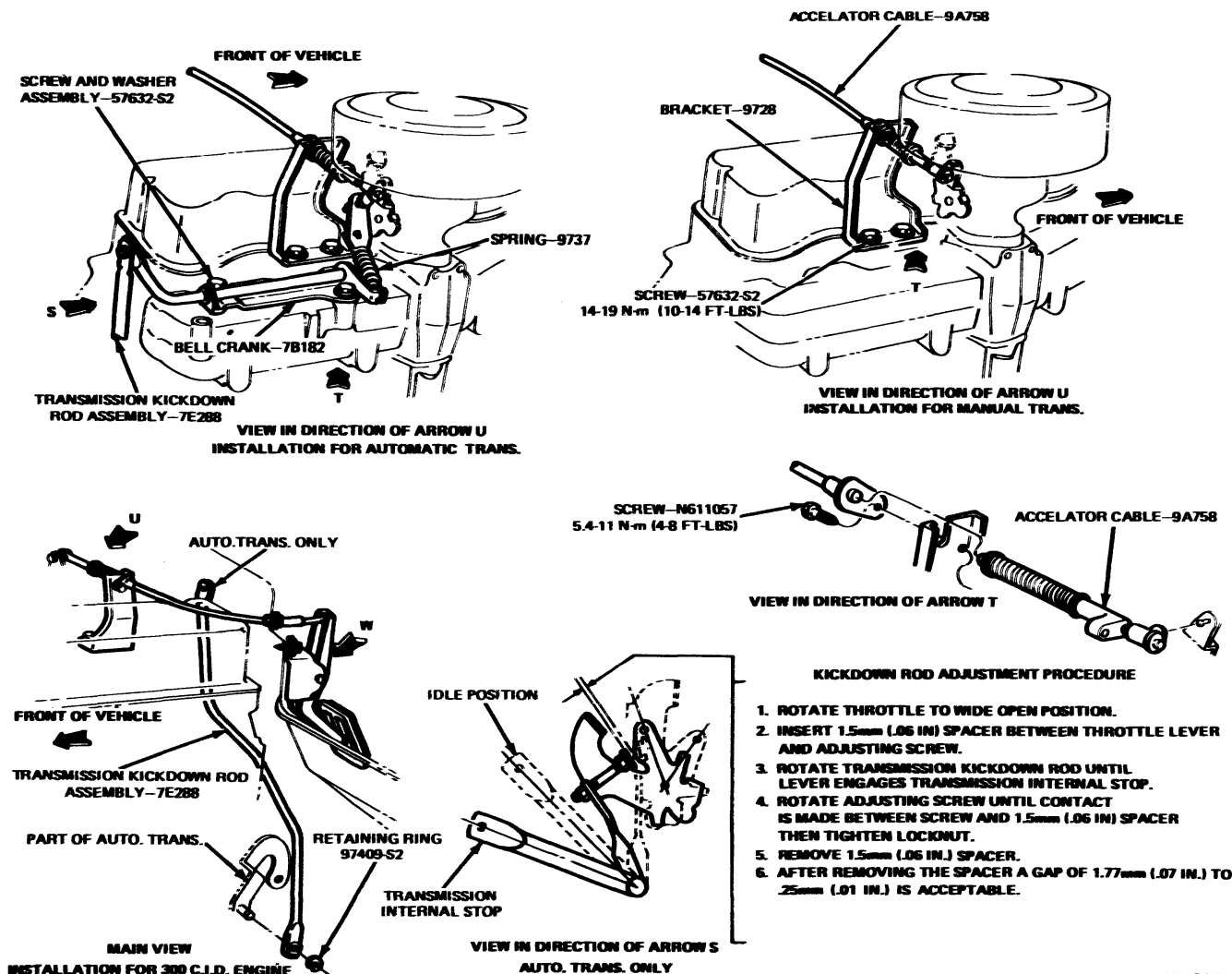


FIG. 3 Throttle Linkage—F-100—F-350 (4x2), F-150—F-250 (4x4) and Bronco with Standard 4.9L (300 CID) 1-6 Six Cyl. Engine

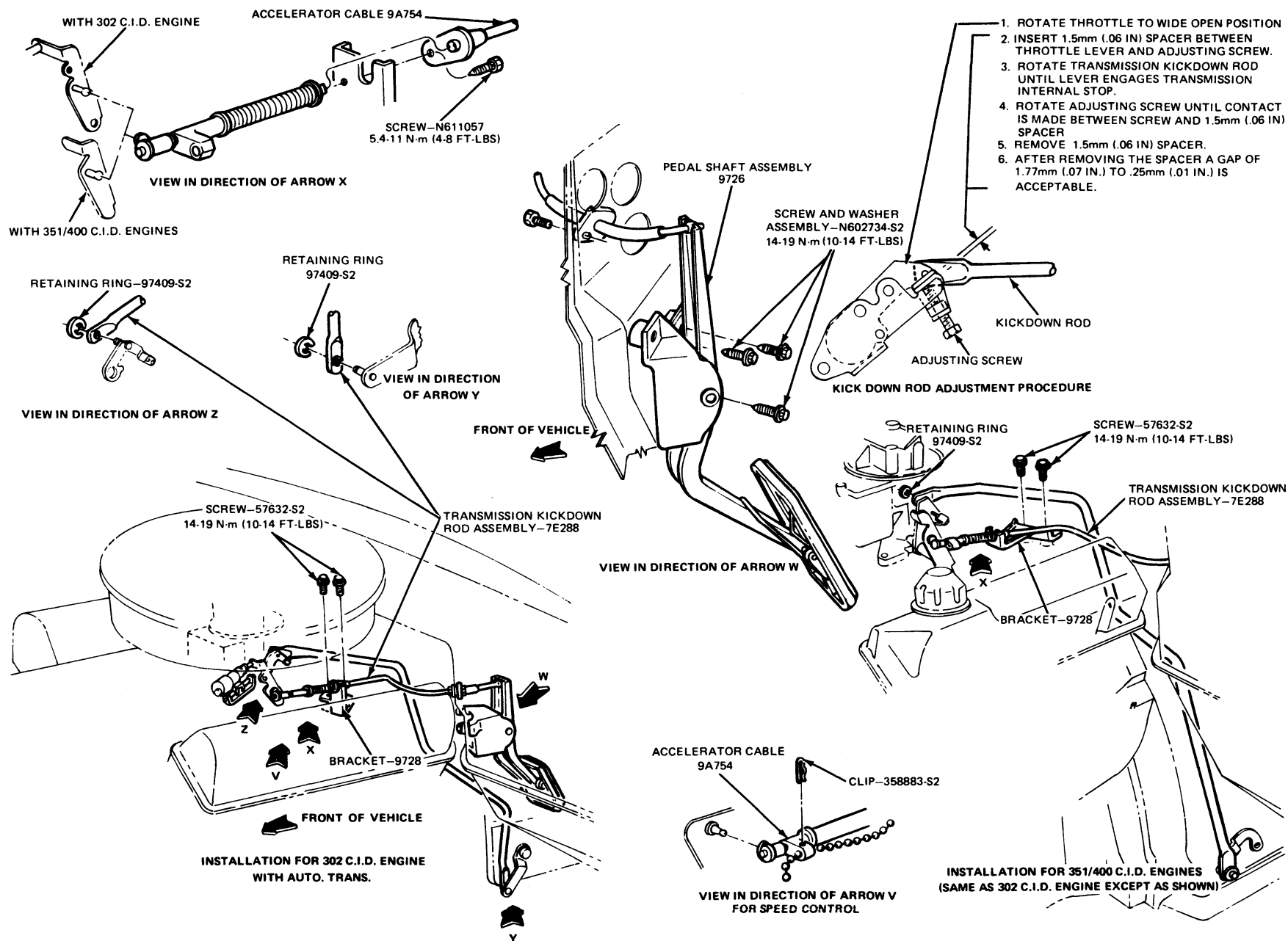


FIG. 4 Throttle Linkage—F-100—F-350 and Bronco with V-8 Engines

EXHAUST SYSTEMS

GROUP
26
(5000)

PART TITLE	PART NO.	PART TITLE	PART NO.
General Exhaust System Service	26-01		

General Exhaust System Service

PART
26-01

APPLIES TO ALL MODELS

SUBJECT	PAGE	SUBJECT	PAGE
ADJUSTMENTS	26-01-10	DESCRIPTION	26-01-1
Catalytic Converter Fastener		DIAGNOSIS AND TESTING	26-01-7
Repair Procedure	26-01-11	Restricted Exhaust System Test	26-01-7
Exhaust System Alignment	26-01-10	SPECIFICATIONS	26-01-11
Brush Shield Inspection	26-01-11		

DESCRIPTION

Only single exhaust systems (Figs. 1 through 3) are available with gasoline engine equipped trucks.

The Y-type inlet pipe on V-8 engines is a one piece unit.

The exhaust systems used on the gasoline engines vary between engine and truck models. Catalytic converters in single-catalyst systems, use a clamshell catalyst of monolithic construction. The catalytic agent is an alloy of platinum and palladium. Most gasoline powered vehicles will employ the catalytic converter in their emission control systems. All gasoline powered vehicles will run on unleaded fuel regardless.

Illustrations given in this Part show typical exhaust systems.

The location and type of exhaust system gaskets, retaining clamps and support brackets are shown in the exhaust system illustrations in the master parts catalog.

This Part covers general exhaust system alignment procedures and specifications.

The exhaust system components are removed, disassembled, assembled and installed using standard tools and procedures.

Always refer to the Master Parts Catalog for parts usage and interchangeability before replacing a component part of the exhaust system.

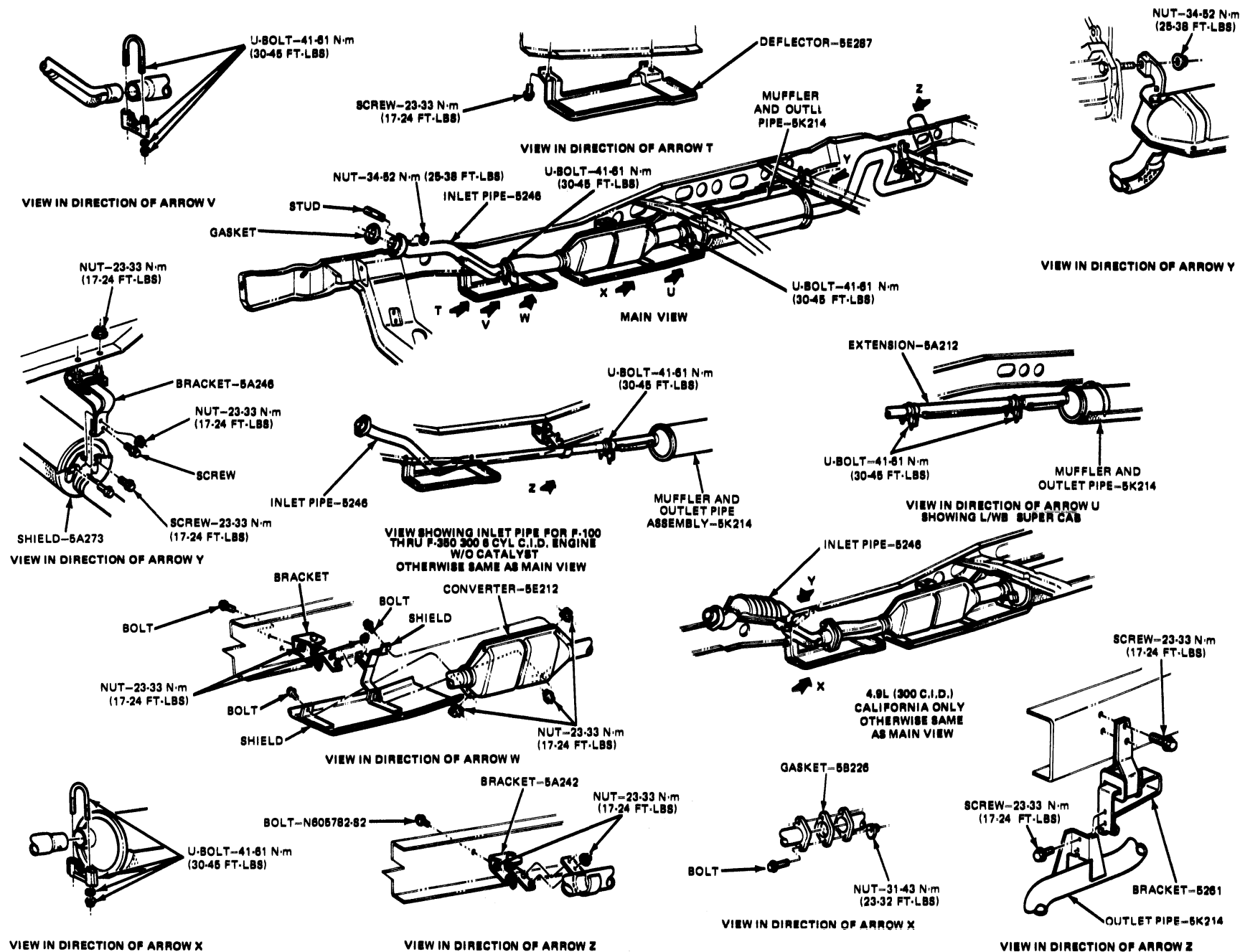


FIG. 1 Typical Six-Cylinder Exhaust System—F-100—F-350 Shown, Bronco and E-100—E-350 Similar

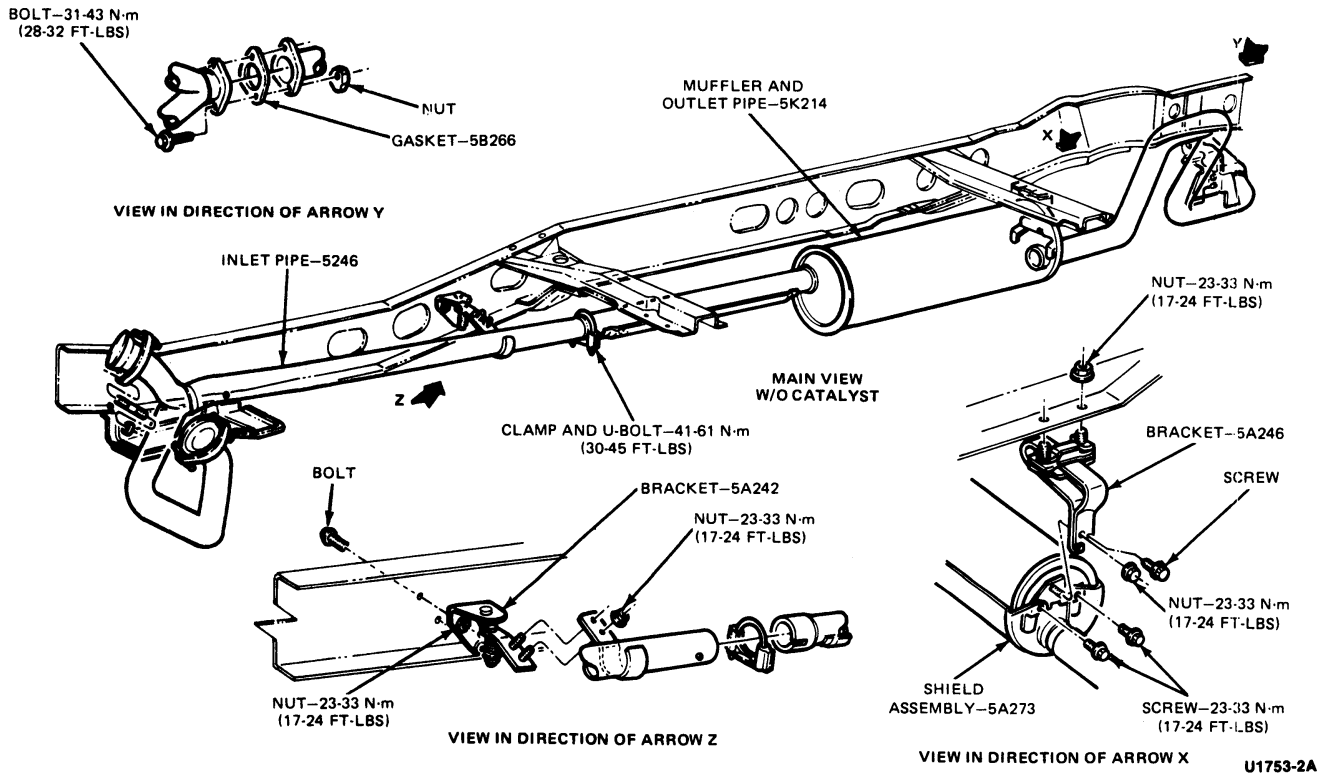


FIG. 3 Typical Eight Cylinder Exhaust System w/o Catalytic Converter—F-100—F-350

DIAGNOSIS AND TESTING

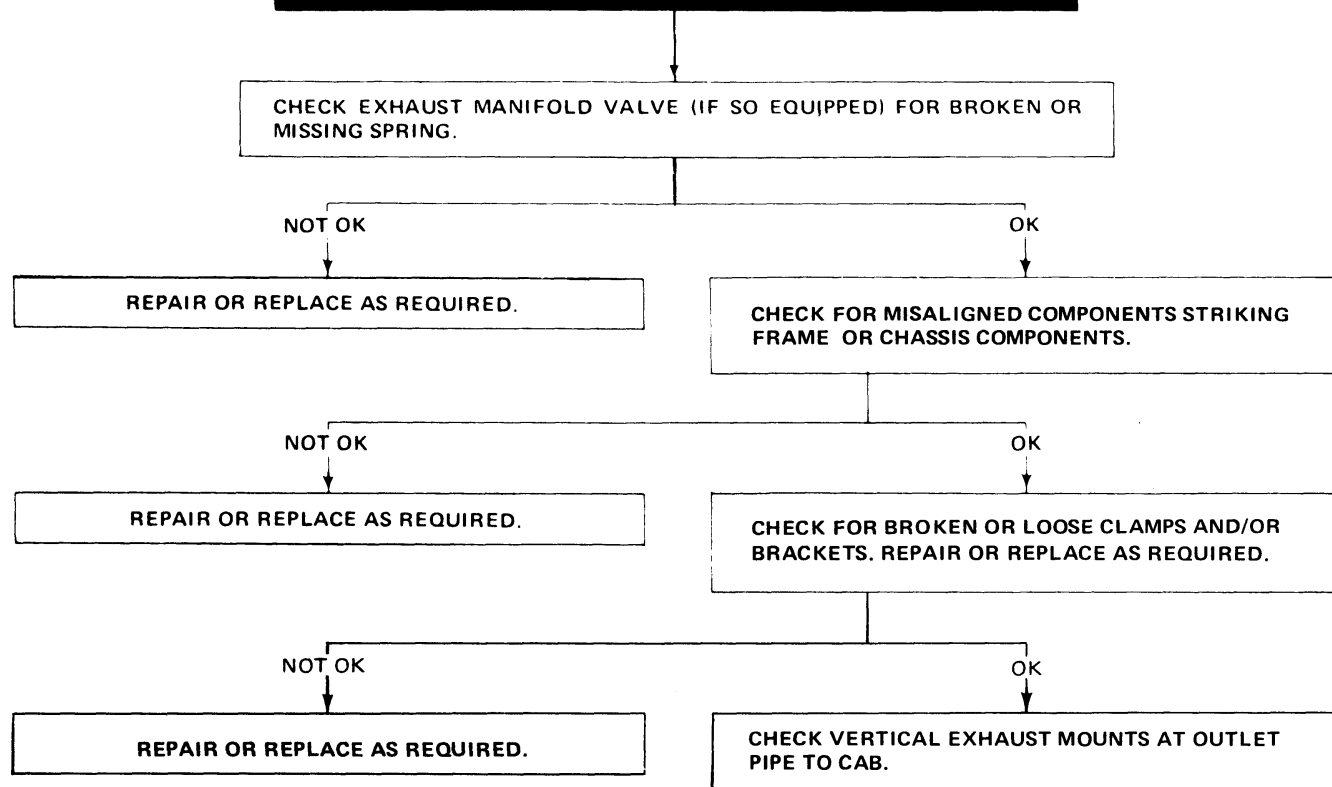
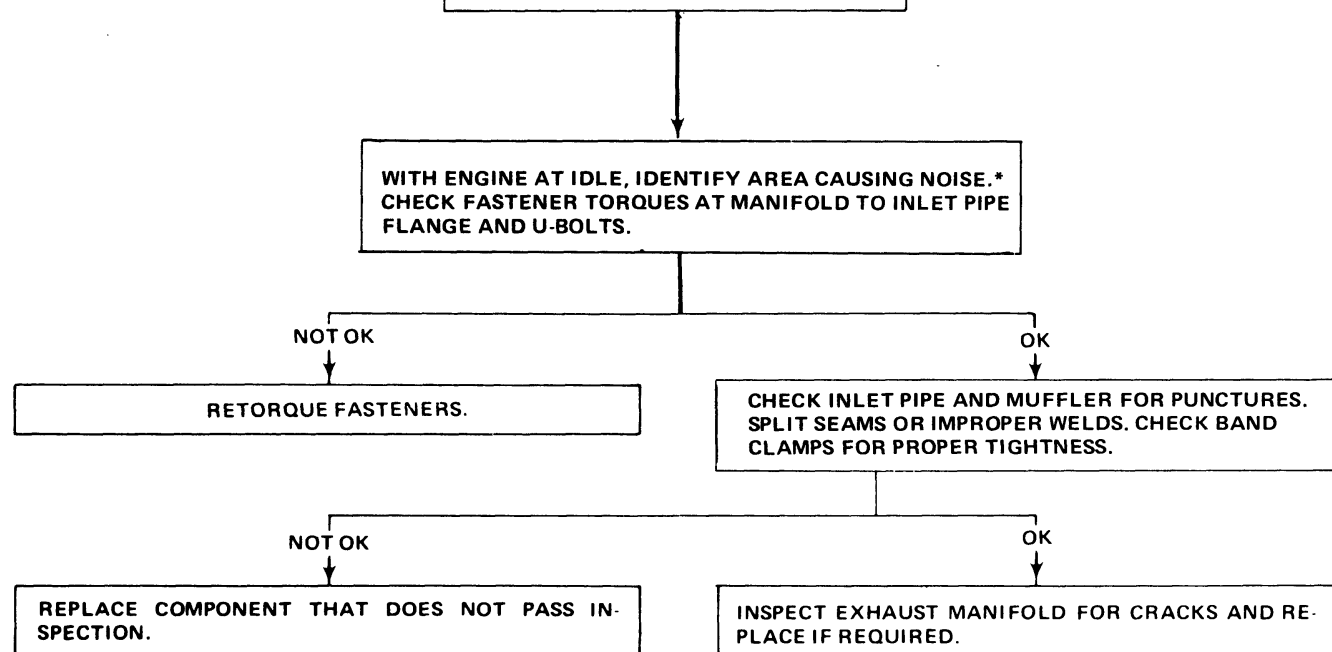
Exhaust system performance complaints such as excessive back pressure or a malfunctioning exhaust control valve are usually noticeable by their effect on engine performance.

However, other malfunctioning components may have similar effects on engine performance and be characterized by the same symptoms or complaints. It is, therefore, necessary to refer to the engine diagnosis and service procedures in Group 29, when attempting to diagnose this type of problem.

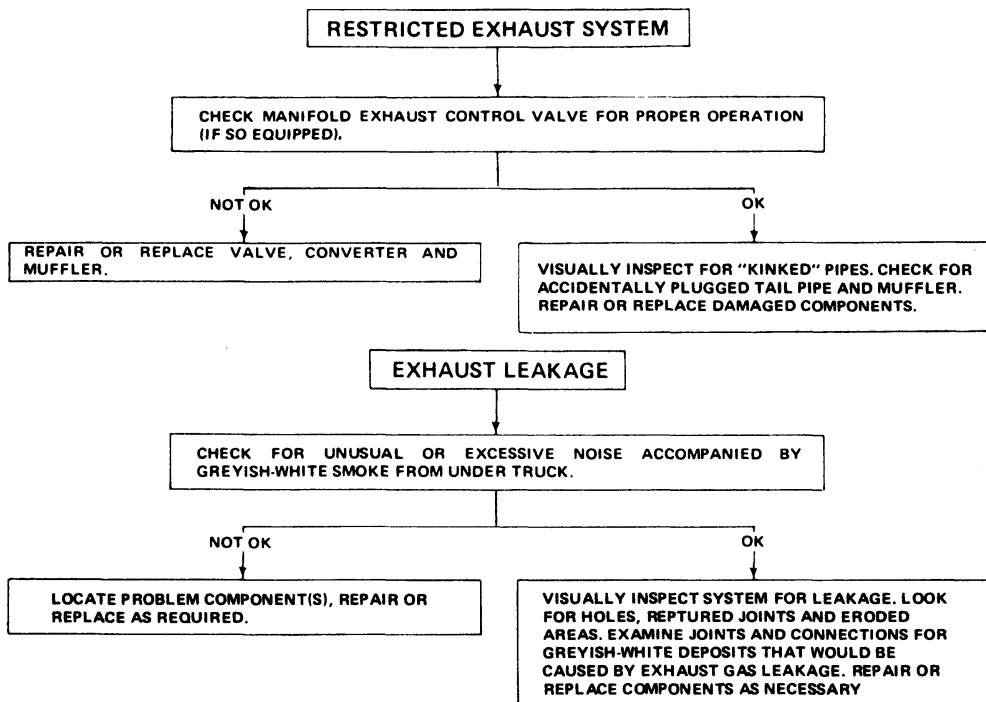
For general exhaust system complaints refer to the diagnosis guide listed in this Part.

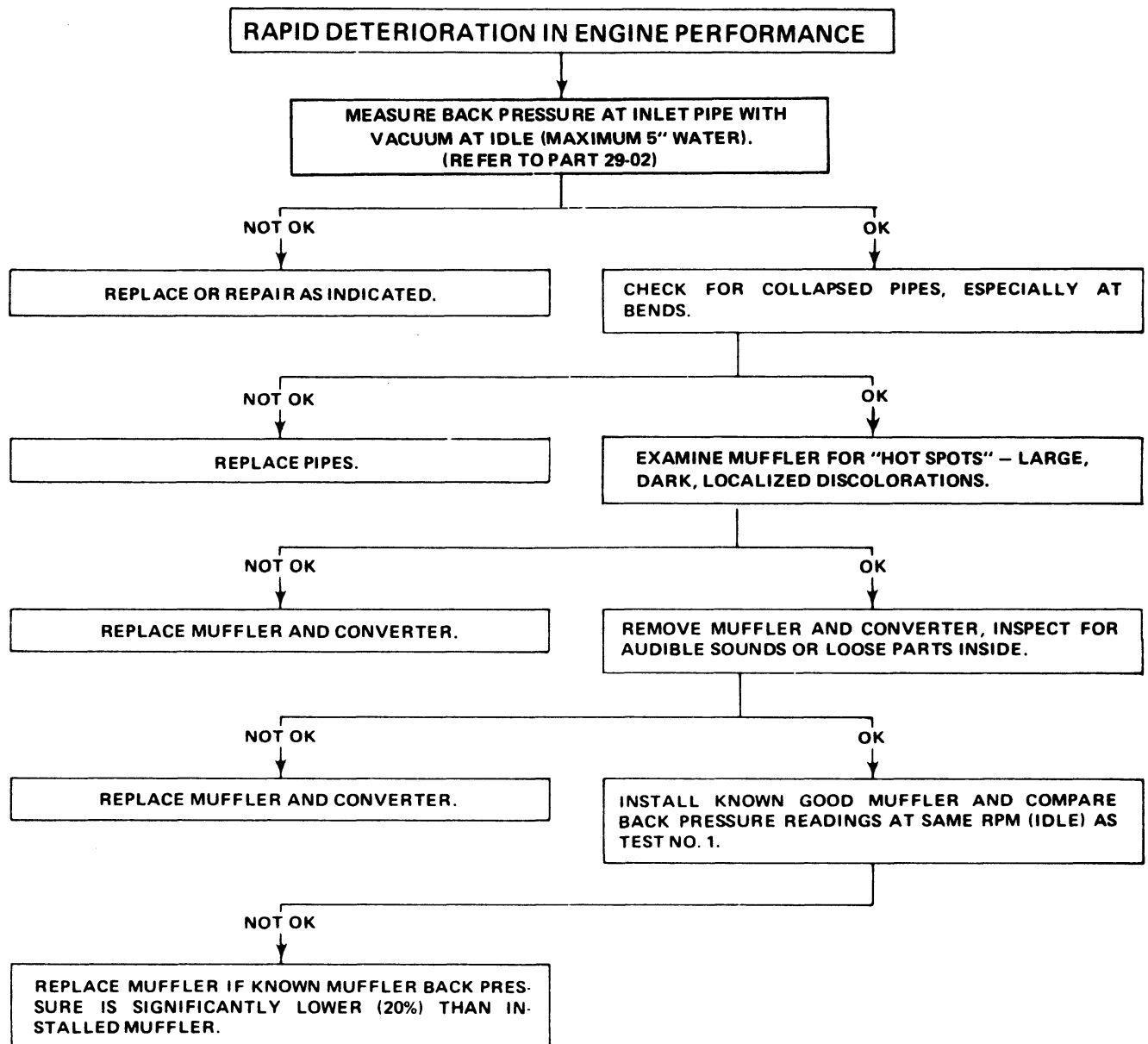
RESTRICTED EXHAUST SYSTEM TEST

With the engine at normal operating temperature, connect the vacuum gauge to the intake manifold. A gradual drop in the vacuum gauge reading at idle will indicate a restricted exhaust system.

VIBRATION OR RATTLING FROM EXHAUST SYSTEM**EXCESSIVE EXHAUST NOISE**

* WHEN NO LEAKAGE IS PRESENT, CHECK TO ESTABLISH THAT MUFFLER PART NUMBER IS CORRECT.





NOTE: ALSO CHECK ENGINE PERFORMANCE PART 29-02 OF THIS MANUAL.

ADJUSTMENTS

Inspect inlet pipes, outlet pipes and mufflers for cracked joints, broken welds and corrosion damage that would result in a leaking exhaust system. Inspect the clamps, brackets and insulators for cracks and stripped or badly corroded bolt threads. When pipe clamp(s) are loosened and/or removed to replace a shield pipe or muffler, replace the clamp(s) if there is reasonable doubt that its service life is limited.

The exhaust system, including brush shields, must be free of leaks, binding, grounding and excessive vibrations.

These conditions are usually caused by loose, broken or misaligned clamps, shields, brackets or pipes. If any of these conditions exist, check the exhaust system components and alignment. Align or replace as necessary.

EXHAUST SYSTEM ALIGNMENT

Perform the following procedure to align the complete exhaust system.

1. Loosen the pipe connection clamps and the pipe support bracket clamps. Loosen the inlet pipe to exhaust manifold attaching nuts.
2. Tighten the exhaust manifold to inlet pipe attaching nuts evenly and alternately to specifications so that the pressure on the gasket and inlet pipe flanges will be uniform on both sides.
3. Work from the front and progressively align the exhaust system components and clamps at the various pipe connections to relieve binds and displaced pipe connections. Then check the exhaust system for leaks.

BRUSH SHIELD INSPECTION

Raise the vehicle on a hoist. Brush shields are positioned on the underside of the catalytic converter and the muffler assembly. Shields should be free from bends which would bring any part of the shield in contact with the converter or muffler assembly. The shield should be clear of any combustible matter.

CATALYTIC CONVERTER FASTENER REPAIR PROCEDURE

A clamshell catalytic converter is used on gasoline engine exhaust systems requiring a converter. Catalytic converters should not be replaced for broken studs, stripped threads or loose nuts. The following procedures are recommended for repairing damaged converter fasteners.

1. For converters with threaded flanges, remove damaged studs and install new studs or a bolt of suitable length. If the flange thread has minor damage, re-tap the hole with a 3/8-16 tap. If the flange thread cannot be repaired, re-size the hole with a 13/32 drill and use a 3/8 diameter bolt of suitable length and a locking nut (45358-57 or equivalent).
2. For converters with loose clinch or weld nuts in the flange:
 - a. Remove the loose nut.
 - b. Dress the flange surface upon which the bolt and washer will rest.
 - c. Fasten the joint with a suitable 3/8 bolt, lock nut and a flat washer between the bolt head and the dressed flange surface.

SPECIFICATIONS

TORQUE LIMITS — EXHAUST SYSTEM BOLTS AND NUTS — GASOLINE (FT-LBS)

Description	Bolt or Nut Size	Torque (ft-lbs)	Description	Bolt or Nut Size	Torque (ft-lbs)
Bracket to Frame Cross-Member			Inlet Pipe to Exhaust Manifold		
Light Trucks	3/8-16	23-32	Light Trucks	7/16-14	25-38
Medium Trucks	3/8-16	15-21	Medium Trucks	3/8-16	20-29
Bracket to Frame Side Rail				7/16-14	31-42
Light Trucks	5/16-18	12-17	Heavy Trucks		
	3/8-16	23-32	Gasoline	3/8-16	24-32
F-250 (4x4) & F-350	3/8-16	23-32	Diesel	3/8-16	20-29
Medium Trucks	5/16-18	12-17		1/2-20	37-50
	3/8-16	25-35		1/2-13	37-50
Heavy Trucks	3/8-16	24-32	Inlet Pipe U-Bolt Light Trucks	3/8-16	30-90
	7/16-14	38-52	Muffler Inlet Pipe Bracket to Engine		
	9/16-12	75-105	Heavy Trucks	3/8-16	15-21
	5/16-18	9-12		1/2-13	37-50
Pipe Joint U-Bolt			Outlet Pipe Clamps Light Trucks "U" Bolt	3/8-16	10-15
Light Trucks	3/8-16	30-90	Hanger Bracket Screw	32-9	7-11

UNLESS OTHERWISE SPECIFIED, THE FOLLOWING TORQUE RANGES ARE
TO BE USED FOR FITTING OR FASTENER DIAMETERS AS INDICATED.

BOLT OR NUT DIAMETER	TORQUE RANGE
5/16"	17-32 N•m (12-17 ft-lbs)
3/8"	43-56 N•m (31-42 ft-lbs)
7/16"	68-94 N•m (50-70 ft-lbs)
1/2"	102-142 N•m (75-105 ft-lbs)

CU1162-2F

COOLING SYSTEM

GROUP
27
(8000)

PART TITLE	PAGE NO.	PART TITLE	PAGE NO.
Ford Cooling System Service	27-02-1	Radiators	27-04-1

Ford Cooling System Service

PART
27-02

APPLIES TO ALL MODELS

SUBJECT	PAGE	SUBJECT	PAGE
CLEANING AND INSPECTION		OPERATION	
Cleaning Cooling System	27-02-8	Corrosion Resistor	
Radiator Pressure Cap	27-02-8	Cummins Diesel Engines	27-02-9
DESCRIPTION	27-02-1	Draining, Filling and Bleeding the	
DIAGNOSIS AND TESTING		Cooling System	27-02-7
Cooling System Pressure Test	27-02-2	SPECIFICATIONS	27-02-9
Cooling System Test	27-02-3		
Diagnosis	27-02-3		
Diagnosis Guides	27-02-4		
General Test Procedures	27-02-2		
Radiator Cap Pressure Test	27-02-3		

DESCRIPTION

Correct coolant level is essential for maximum circulation and adequate cooling. In addition, for the cooling system to perform its function, it must receive proper care. This includes keeping the radiator fins clean and a periodic inspection of the cooling system for leakage.

Use care when removing the radiator cap to avoid injury from escaping steam or hot water.

When cooling system is drained, fill radiator with specified coolant, vent the system by disconnecting heater upper hose and add fluid to specified level.

In production Bronco and F-100—F-350 cooling systems are filled with a 45-55 (50-50 for Canada, Seattle, Salt Lake City, Twin Cities and export sales districts) solution of Ford Permanent Anti-freeze and water which prevents corrosion, keeps the cooling system clean, provides anti-freeze protection to -20 to

-35 degrees F in winter and provides for higher summer operation temperatures.

For the most effective cooling system operation, this mixture strength should be maintained all year round and in all climates.

All coolant added should be the specified mixture of Ford permanent anti-freeze and water. If Ford Permanent anti-freeze is not available, another reputable permanent anti-freeze may be used and diluted with an equal quantity of water.

Ordinary tap water may be used in an emergency except in areas where the water is known to be exceptionally hard or to have a high alkali content. The cooling system should be drained and flushed and the proper mixture of anti-freeze added as soon as possible.

To avoid possible overheating in very hot weather, do not use mixtures with more than 50 percent anti-

freeze except in areas where anti-freeze protection below 35 degrees F is required. In this case, refer to the coolant mixture chart on the Ford permanent anti-freeze container.

A standard ethylene glycol hydrometer can be used to check the protection level of the long-life coolant or Rotunda Anti-Freeze Tester (#720005) or equivalent.

To prevent damage to the cooling system during periods of below freezing ambient temperature, when water or anti-freeze is added to the supply tank, always

operate the engine at fast idle for 30 minutes before letting the truck stand with the engine off for prolonged periods. This will allow a uniform mixture throughout the cooling system and prevent damage by freezing, when sufficient anti-freeze is used.

If the fan drive belt(s) is noisy, check the tension of the belt(s) to make certain it is within specifications. Also, check for misaligned pulleys. If the drive belt(s) is worn or frayed, replace, following the procedure in Part 27-04.

DIAGNOSIS AND TESTING

GENERAL TEST PROCEDURES

VISUAL INSPECTION

- A. Check for leaks at:
 1. All hoses and hose connections.
 2. Radiator seams, radiator core, and radiator drain petcock.
 3. All block core plugs and drain plugs.
 4. Edges of all other cooling system gaskets.
 5. Transmission oil cooler.
 6. Vehicle heating system components.
 7. Water pump.
- B. Examine oil dipstick for evidence of coolant contaminated with engine oil.
- C. Check radiator for evidences of oil in coolant (leakage at transmission oil cooler).

Install the Rotunda Cooling System Analyzer (Fig. 1) (75-001) or equivalent to assist in testing the cooling system. Follow the manufacturers recommended corrections and testing procedures.

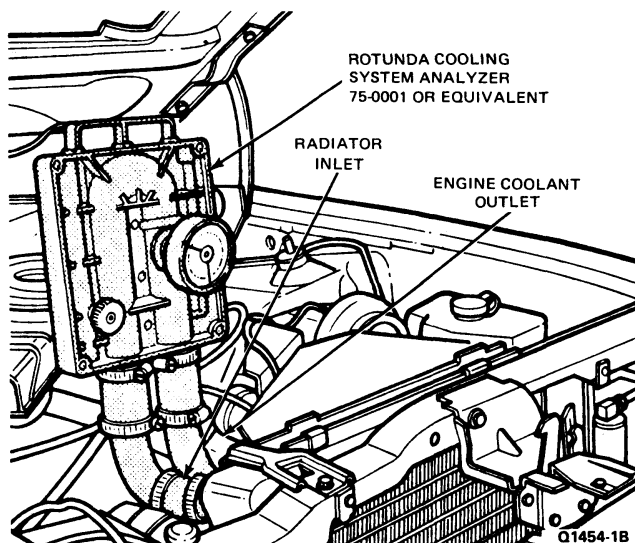


FIG. 1 Cooling System Analyzer Installed—Crossflow Radiator

COOLING SYSTEM PRESSURE TEST

1. Shut the engine off.

WARNING—Never remove the radiator cap under any conditions while the engine is operating. Failure to follow these instructions could result in damage to the cooling system or engine and/or personal injury. To avoid having scalding hot coolant or steam blow out of the radiator, use extreme care when removing the cap from a hot radiator. If possible, wait until the engine has cooled, then wrap a thick cloth around the radiator cap and turn it slowly to the first stop. Step back while the pressure is released from the cooling system. When you are sure all the pressure has been released, press down on the cap (still with a cloth), turn and remove it.

2. Adjust the radiator coolant (Fill or drain) to one inch below the filler neck opening before testing. Wet the rubber sealing surface of the cap before installing the cap tightly on the radiator.
3. Disconnect the electrical connector from the coolant temperature sending unit and remove the temperature sending unit from the engine.

With the radiator cap installed and the cooling system pressure relieved, only a small amount of coolant will be lost when the sending unit is removed.
4. Install the adapter fitting from the pressure tester 21-0012 (or equivalent) (male thread on one end, and a hose connector on the other end to accommodate the tester hose) tightly into the intake manifold or cylinder head in place of the sending unit. (See Fig. 2.)
5. On E-100—E-350, remove the radiator overflow hose from the retainer clips. If vehicle is equipped with an expansion bottle system, use a separate hose. Make sure the hose is firmly installed on the radiator overflow nipple and is in good condition. Insert the free end of the overflow hose into a container of water.
6. On Bronco and F-100—F-350, remove the radiator overflow hose from the overflow nipple. Install a separate hose firmly on the overflow nipple. Insert the free end of separate hose into container of water.
7. Attach the pressure pump and gauge (Fig. 2) to the adapter-fitting and pressurize the cooling system to the cap LOWER LIMIT as shown in the test chart.

No bubbles should appear in the water container when the system is pressurized to the LOWER LIMIT. If the system is satisfactory at the lower limit, gradually increase the system pressure until a slight stream of bubbles appears in the water container. This is the upper limit of the pressure cap.

Replace any radiator cap that exceeds the specified UPPER LIMIT pressure without discharging bubbles.

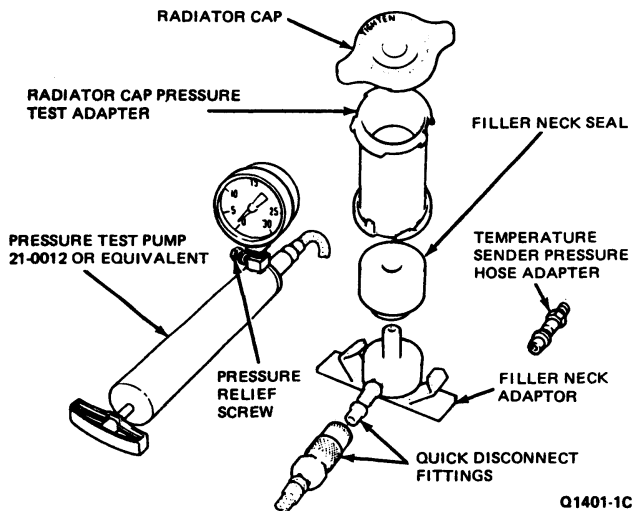


FIG. 2 Pressure Test Pump and Attachments

8. If the radiator cap does not hold pressure, remove and wash the cap in clean water to dislodge all foreign particles from the gaskets. Check the sealing surface in the radiator filler neck.

Inspect the cam lock flanges on both sides of the filler neck for maximum cap engagement.

9. Pressurize the cooling system as outlined in Step 6 or 7 (using a radiator cap that operates within the specified upper and lower pressure limits) and observe the gauge reading for approximately two minutes. Pressure should be held between 10 and 13 psi and should not drop during this time.

RESULTS: If the pressure drops, check for leaks at the engine to heater core hoses, engine to radiator hoses, bypass hose, water valve hose (if applicable), thermostat housing gasket, radiator and heater core, etc. Also refer to engine system checks if a leak cannot be located in the cooling system. Any leaks which are found must be corrected and the system rechecked.

If the system holds pressure proceed to Step 10.

10. Release the system pressure by loosening the radiator cap and remove the adapter. Reinstall the temperature sending unit, check coolant level and replenish (if necessary) with the correct coolant solution.

RADIATOR CAP PRESSURE TEST

Refer to Fig. 2.

1. Remove the radiator cap from the radiator filler neck.

2. Use water to clean the cap in the area of the rubber seal and the vacuum relief valve. Refer to Cleaning and Inspection for procedure. Immerse the radiator cap in water and install on the shallow filler neck of the 21-0012 Radiator Cap Pressure Test Adapter or equivalent adapter.

NOTE: The adapter is designed to accept both deep and shallow neck radiator caps.

3. Immerse the filler neck seal in water and install in the filler neck adapter.

NOTE: The filler neck seal is reversible so that it may be used on either a deep or shallow radiator filler neck. It will also fit either end of the radiator cap pressure test adapter.

4. Install the filler neck adapter with filler neck seal on the deep filler neck end to the radiator cap pressure test adapter.
5. Connect the female quick disconnect fitting of the pressure test pump to the male quick disconnect fitting of the filler neck adapter.
6. SLOWLY depress the plunger of the pressure test pump until the pressure gauge reading stops increasing and note the highest pressure reading obtained.

NOTE: If the plunger of the pump is depressed too fast, an erroneous pressure reading will result.

7. Release the pressure by turning the pressure relief screw counterclockwise. Then tighten the pressure relief screw and repeat Step 6 (at least twice) to be sure the pressure test reading is repeatable within the acceptable gauge reading limits of the radiator cap and is not erratic. Refer to Specifications at end of Part 27-04.
8. If the pressure test gauge readings are not within the acceptable gauge reading limits, replace the radiator cap. If the pressure test gauge readings are within the acceptable gauge reading limits, perform the Cooling System Pressure Test.

COOLING SYSTEM TEST

A. Check for leaks at:

1. All hoses and hose connections.
2. Radiator seams, radiator core, radiator gaskets (radiators with bolt on tanks), and radiator drain petcock.
3. All block core plugs and drain plugs.
4. Edges of all other cooling system gaskets.
5. Transmission oil cooler (trucks equipped with automatic transmission).
6. Truck heating system components.
7. Water pump shaft and bushing.

B. Examine engine oil dipstick for evidence of coolant contaminated oil.

C. Check radiator for evidence of oil in coolant (leakage at automatic transmission oil cooler).

DIAGNOSIS

Refer to the following Diagnosis Guides for cooling system complaints, their possible cause and

recommended resolution. Refer to the pertinent Part for testing and repair.

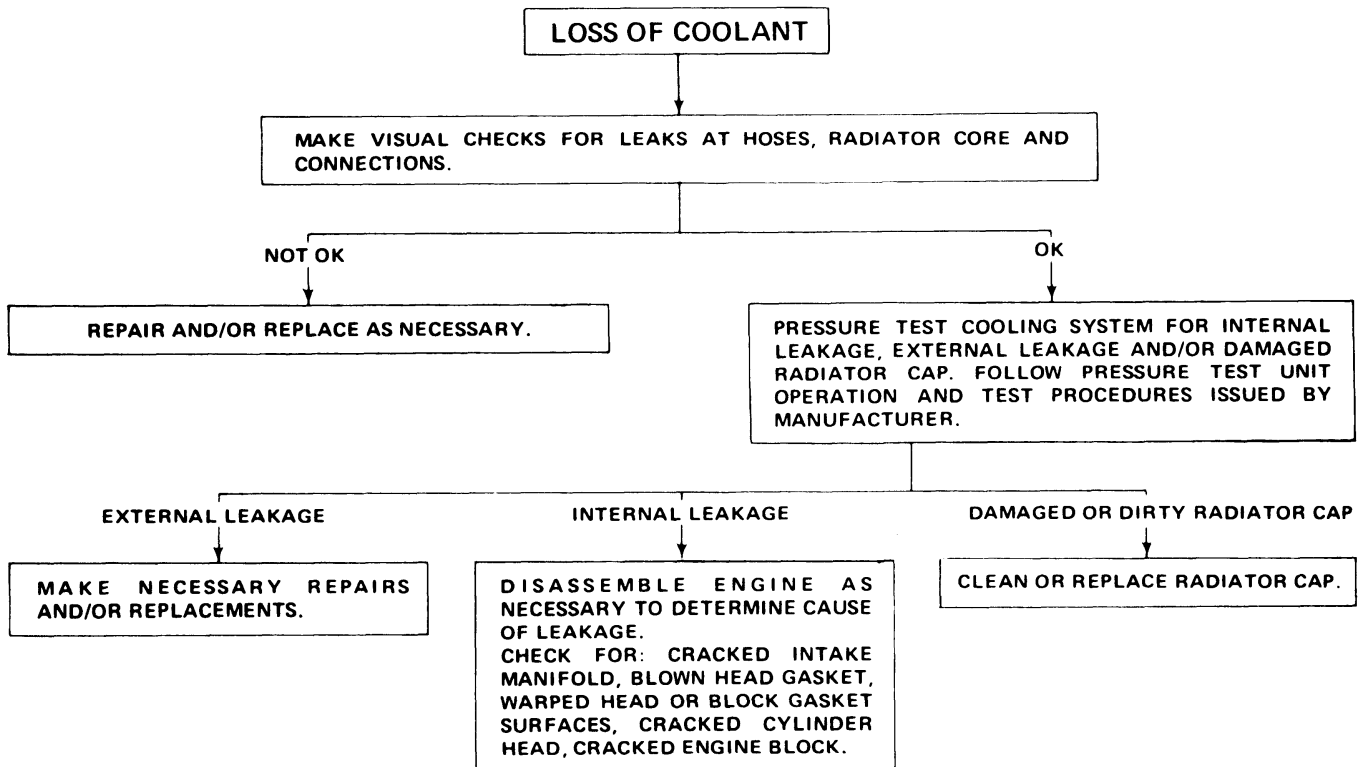
Use the Rotunda Cooling System Analyzer (75-0001) or equivalent (Fig. 1) to assist in diagnosing the cooling system. Follow the manufacturers instructions for connections at testing.

The most frequent cooling system complaints concern leakage and overheating. Either of these problems will soon render the vehicle inoperable.

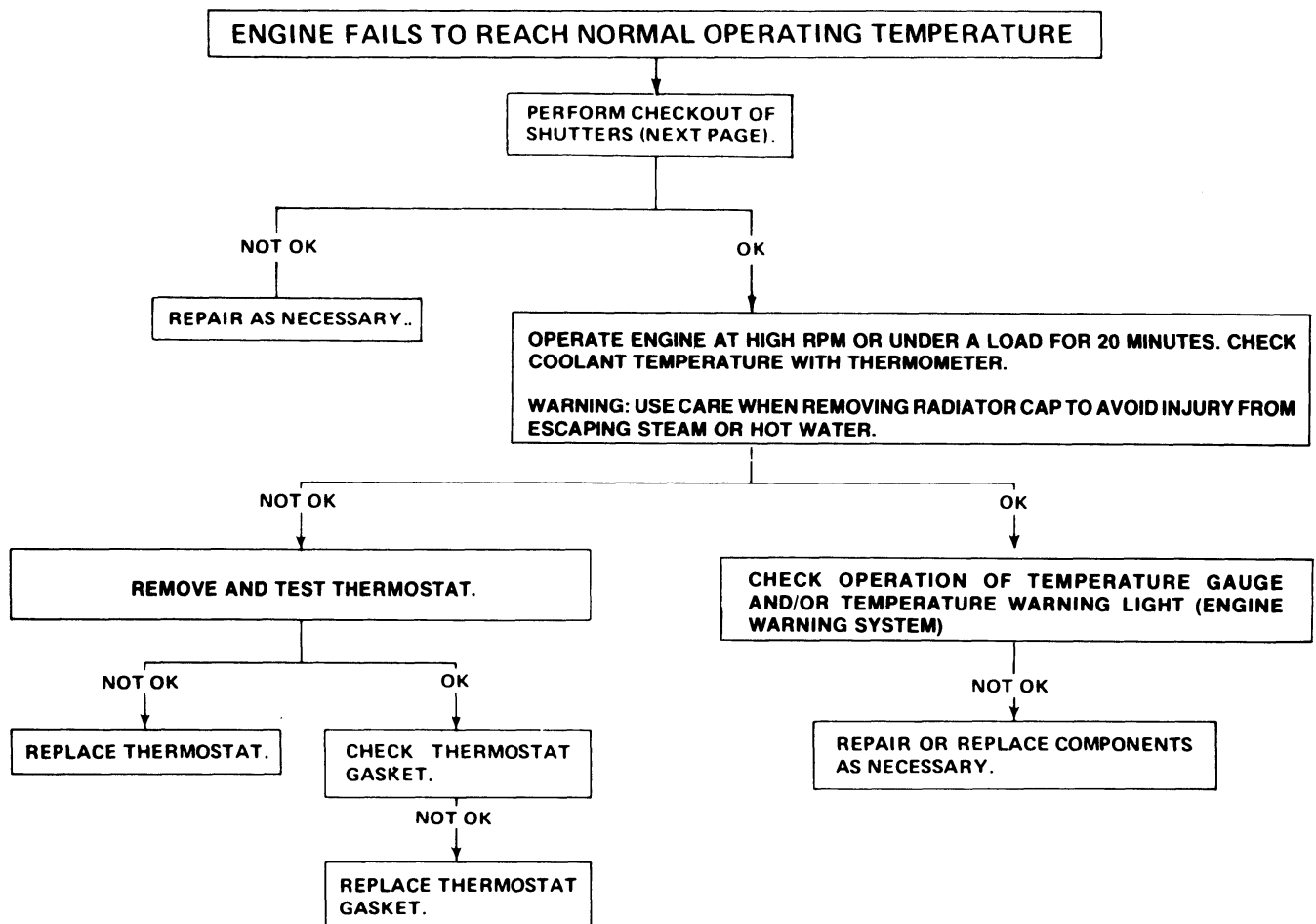
Most vehicles use an Ethylene glycol base anti-freeze solution to which the manufacturers have added a dye color. The dye color makes the anti-freeze solution an excellent leak detector. If this type of solution is not being used in the cooling system, a vegetable dye may be added to aid in locating external leakage.

DIAGNOSIS GUIDES

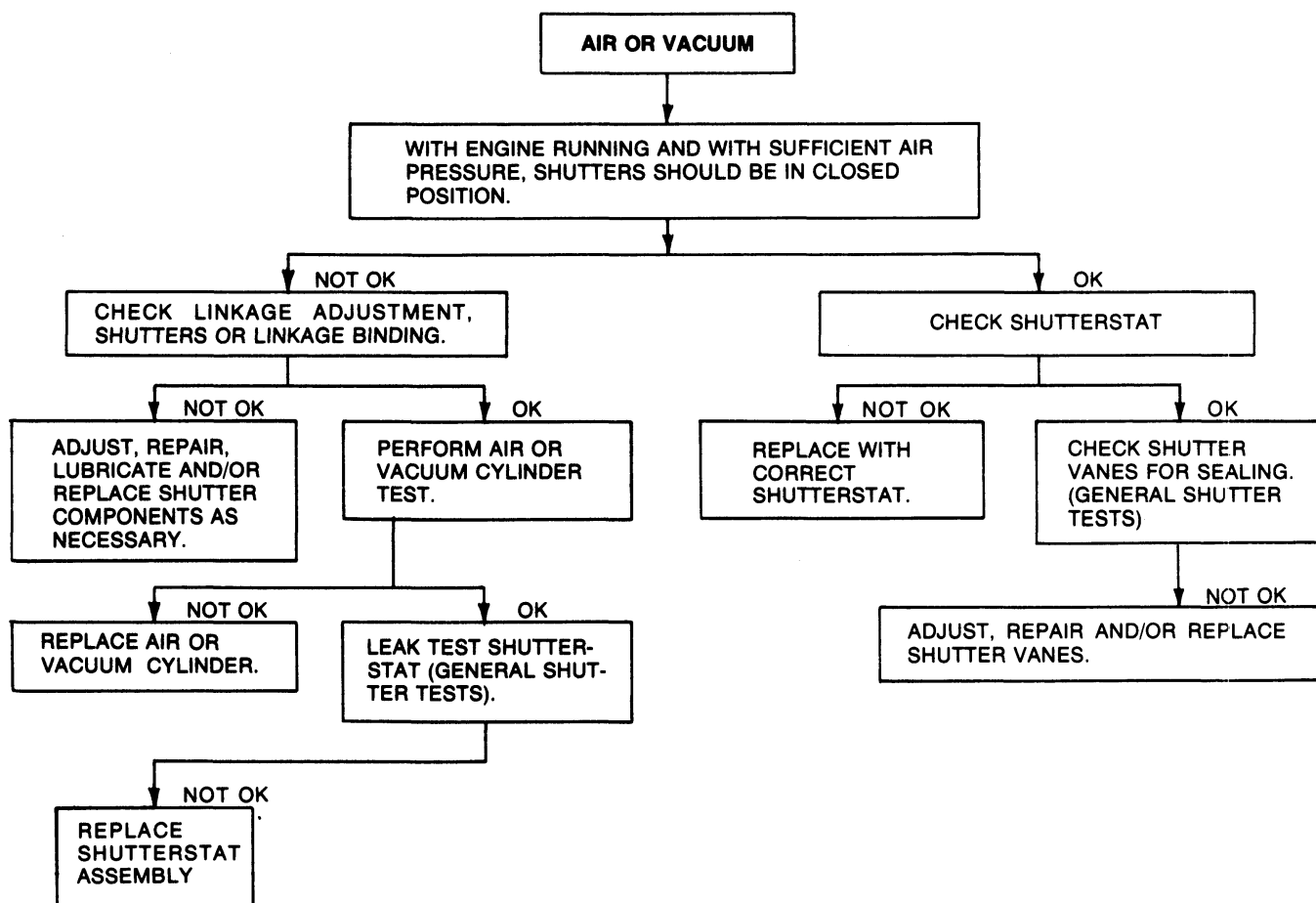
CONDITION	POSSIBLE CAUSE	CORRECTION
• Loss of coolant	• Pressure cap and gasket. • Leakage. • External leakage. • Internal leakage.	• Inspect, wash gasket and test. Replace only if cap will not hold pressure test specification. • Pressure test system. • Inspect hose, hose connection, radiator, edges of cooling system gaskets, core plugs and drain plugs, transmission oil cooler lines, water pump, heater system components. Repair or replace as required. • Disassemble engine as necessary — check for: cracked intake manifold, blown head gaskets, warped head or block gasket surfaces, cracked cylinder head or engine block.
• Engine overheats	• Low coolant level. • Loose fan belt. • Pressure cap. • Radiator or A/C condenser obstruction. • Closed thermostat. • Ignition. • Temp gauge or cold light. • Engine.	• Fill as required. Check for coolant loss. • Adjust. • Test. Replace if necessary. • Remove bugs, leaves, etc. • Test, replace if necessary. • Check timing and advance. Adjust as required. • Check electrical circuits and repair as required. Refer to Body, Electrical and Chassis Shop Manual. • Check water pump, block for blockage.
• Engine fails to reach normal operating temperature	• Open thermostat. • Temperature gauge or cold light.	• Test, replace if necessary. • Check electrical circuits and repair as required. Refer to Electrical section.

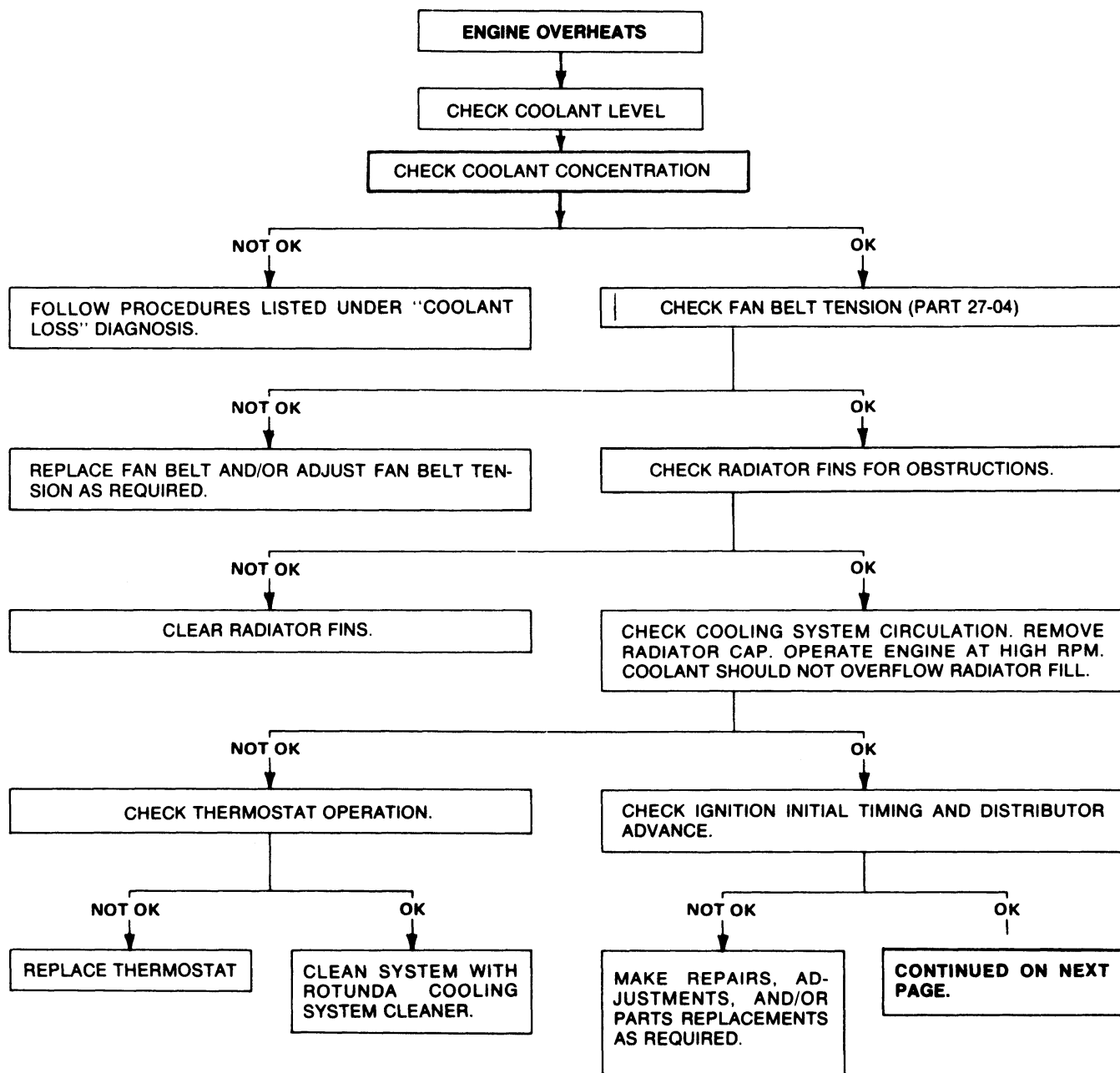


CQ1467-2A



CQ1468-2A





CQ1470-2A

OPERATION

DRAINING, FILLING AND BLEEDING THE COOLING SYSTEM

To prevent loss of anti-freeze when draining the radiator, attach a hose on the radiator drain cock and drain the coolant from the radiator into a clean container.

To drain the radiator, open the drain cock located at the bottom of the radiator and remove the radiator or supply tank cap. The cylinder block of the V-8 engine is drained by removing the drain plugs located on both

sides of the block. The 6-cylinder engines have one drain plug located at the left rear of the cylinder block.

To fill the cooling system, install the cylinder block drain plug(s) and close the radiator drain cock. Disconnect the heater outlet hose at the water pump to bleed or release trapped air in the system. When the coolant begins to escape, connect the heater outlet hose.

Fill the radiator until the coolant is flush with the cap seal in the filler neck to 1.5 inches below the cap seal.

CLEANING AND INSPECTION

CLEANING COOLING SYSTEM

To remove rust, sludge and other foreign material from the cooling system, use Rotunda Cooling System Cleanser or equivalent. Removal of such material restores cooling efficiency and avoids overheating. **Always remove the thermostat prior to pressure flushing. A pulsating or reversed direction of flushing water flow will loosen sediment more quickly than a steady flow in the normal direction of coolant flow. In severe cases where cleaning solvents will not properly clean the cooling system for efficient operation, it will be necessary to use the pressure flushing method. Various types of flushing equipment are available.**

RADIATOR PRESSURE CAP

1. Inspect the areas under the vacuum valve and rubber seal for rust or dirt particles (Fig. 3).

2. Use warm tap water, raise the vacuum valve and rubber seal and thoroughly flush away loose rust or dirt particles trapped under the vacuum valve, rubber seal and on the seal surface.
3. Inspect and remove any imbedded rust or dirt particles on the sealing surfaces of the rubber seal.
4. Inspect the radiator filler neck opening for rust or dirt particles on the sealing surface at the bottom of the filler neck opening. Use a clean cloth and wipe the sealing surface to remove any rust or dirt particles.

NOTE: If paint is observed on the filler neck sealing surface, remove it using paint thinner.

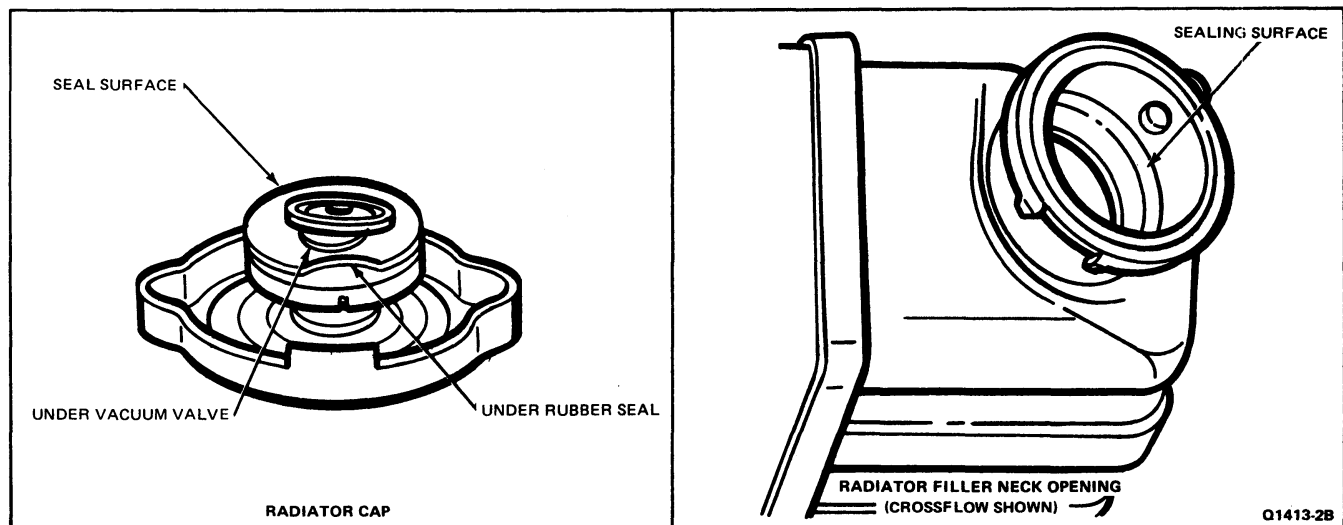


FIG. 3 Cleaning and Inspecting Radiator Cap and Filler Neck Opening

SPECIFICATIONS

ENGINE COOLING SYSTEM REFILL CAPACITIES — F-100 THROUGH F-350, BRONCO, AND E-100 THROUGH E-350

Engine	Truck Model/Type	Equipment	Approximate Capacity		
			U.S. Quarts	Imperial Quarts	Litres
4.9L (300 CID) I-6	F-100/350	Manual Trans. — Standard and Extra Cooling	13	10	12
	F-100/350	Auto. Trans. — Standard and Extra Cooling	14	11	13
	F-100/350	Manual/Auto. Trans. — A/C	17	14	16
5.0L (302 CID) V-8	F-100/150	Manual/Auto. Trans. — Standard Cooling; Manual Trans. — Extra Cooling	15	12	14
	F-100/150	Auto. Trans. — Extra Cooling; Manual/Auto. Trans. — A/C	18	15	17
	F-100/150	Auto. Trans. — Extra Cooling; Manual/Auto. Trans. — A/C	18	15	17
5.8L (351 CID)	F-100	Manual Trans. — Standard Cooling	17	14	16
	F-150/350	Manual Trans. — Standard Cooling	15	12	14
	F-100	Manual Trans. — Standard and Extra Cooling	17	14	16
	F-150/350	Manual Trans. — Extra Cooling; Auto. Trans. — Standard and Extra Cooling	17	14	16
	F-150/350	Manual/Auto. Trans. — A/C	18	15	17
	F-100/350	Manual/Auto. Trans. — Super Cooling	24	19	23
6.6L (400 CID)	F-250/350	Manual Trans. — Standard and Extra Cooling, and A/C	18	15	17
	F-100/350	Auto. Trans. — Standard and Extra Cooling, and A/C	18	15	17
	F-250/350	Manual Trans. — Super Cooling	24	19	23
	F-100/350	Auto. Trans. — Super Cooling	24	19	23
5.8L (351 CID)	Bronco	Manual Trans. — Standard Cooling	20	16	19
		Extra Cooling	22	18	21
		Air Conditioning			
		Auto. Trans. — Standard Cooling			
		Extra Cooling			
		Air Conditioning			
		Heavy Duty Trailer Towing Package			
6.6L (400 CID)	Bronco	Super Cooling	24	19	23
		All — Except Super Cooling	22	18	21
		Super Cooling	24	19	23
4.9L (300 CID)	E-100 — E-350	With Manual and Automatic Trans. Without Air Conditioning ① ③	15	12	14
		With Air Conditioning ① ②	20	16	19
5.0L (302 CID) V-8	E-100 — E-350	Standard Manual Trans. — Extra Cooling	15	12.5	14.2
		Automatic Trans. — Extra Cooling — A/C	17.5	14.5	16.6
5.8L (351 CID)	E-100 — E-150	Manual Trans. — With Air Conditioning ① ③	15	12	14
		Automatic Trans. — With/without Air Conditioning ① ②	20	16	19
5.8L (351 CID)	E-250 — E-350	All Except Super Cool	20	16	19
		Super Cool Option	27	22	25
6.6L (400 CID)	E-250 — E-350	All Except Super Cool	20	16	19
		Super Cool Option	27	22	25
7.5L (460 CID)	E-350	All Options ① ③	28	23	26

① Add 1 U.S. quart (or equivalent Imperial quarts or litres) for heater.

③ Add 1.8 U.S. quarts (or equivalent Imperial quarts or litres) for auxiliary heater (Econoline models).

SPECIAL TOOLS

Number	Description
210012	Cooling System Pressurization Kit
720002	Cooling System Pressurization Kit
720005	Anti-Freeze Tester
750001	Cooling System Analyzer

Radiators

PART 27-04

APPLIES TO ALL MODELS

SUBJECT	PAGE	SUBJECT	PAGE
ADJUSTMENTS	27-04-2	REMOVAL AND INSTALLATION (Cont'd.)	
CLEANING AND INSPECTION	27-04-6	Trucks with Automatic	
DESCRIPTION AND OPERATION	27-04-1	Transmission	27-04-4
REMOVAL AND INSTALLATION		Trucks with Coolant Recovery	
Fan		System	27-04-4
All with 6-Cylinder Engines	27-04-2	Radiator Hose	27-04-3
Fan Belt		Radiator Supply Tank	27-04-4
All Gasoline Engines	27-04-2	Thermostat	27-04-3
Radiator	27-04-3	6-Cylinder Engines — Gasoline	27-04-3
Fittings	27-04-3	V-8 Engines — Gasoline	27-04-3
Radiator Shrouds	27-04-3	SPECIFICATIONS	27-04-7
		TESTING	27-04-2

DESCRIPTION AND OPERATION

RADIATOR

ECONOLINE

All radiators are of the tube and serpentine type with the tubes arranged for vertical flow of the coolant. Two header tanks, one on the top and one on the bottom of the radiator provide uniform distribution of the coolant to the tubes. The radiator outlet port(s) (lower header tank) is connected to the water pump inlet port. The radiator inlet port(s) (upper header tank) is connected to the coolant outlet elbow of the engine, thereby permitting coolant circulation through the radiator when the thermostat is open.

F-100 THROUGH F-350 AND BRONCO

All radiators are the tube and serpentine type with the tubes arranged for horizontal flow of the coolant. Two header tanks, one on each end of the radiator, allow uniform distribution of engine coolant to the radiator tubes. The radiator outlet port (lower hose connection) is connected by hose to the water pump inlet port. The radiator inlet port (upper hose connection) is connected by hose to the coolant outlet elbow of the engine. This allows coolant circulation through the radiator when the engine thermostat is open.

COOLANT RECOVERY SYSTEM

Coolant recovery systems are standard on F-100—F-350 and Bronco. Maintain the coolant level in the radiator flush with the cap seal in the filler neck to 1.5 inches below the cap seal. **CAUTION: Do not remove the radiator cap when the cooling system is hot.**

When cooling system is drained, fill radiator with coolant according to the instructions in Part 27-02.

HEATER CORE BACK-FLUSHING

All engine cooling system flushing and back-flushing procedures must include a separate back-flushing of the Heater or A/C system heater core, after the flushing or back-flushing of the engine cooling system, to prevent engine cooling system particles from clogging the heater core tubes and reducing (or eliminating) coolant flow through the heater core. **The heater core must be back-flushed separately from the engine cooling system for proper back-flush water flow direction through the heater core.**

The correct heater core back-flushing procedure is as follows:

1. Disconnect the heater core outlet heater hose from the water pump fitting and install a female garden hose-end fitting adaptor in the end of the outlet heater hose. Secure with a hose clamp.
2. Connect the female garden hose-end of the outlet heater hose to the male end of a water supply garden hose.
3. Disconnect the heater core inlet heater hose from the engine block fitting and allow to drain onto the ground or into a floor drain.
4. If a water valve is installed in the heater core inlet heater hose, check to be certain the water valve is open (no vacuum).
5. Turn the water supply valve ON and OFF several times so that the surge action will help to dislodge larger stubborn particles from the heater core tubes. Allow full water pressure to flow for approximately five (5) minutes.
6. If a water valve is installed in the heater core inlet heater hose, apply vacuum to the water valve vacuum motor to assure proper operation of the water valve and proper closure with no water leakage. Replace the water valve if required.

7. Remove the hose clamp and female garden hose-end adaptor from the end of the outlet heater hose and re-connect the outlet heater hose onto the water pump fitting.
8. Re-connect the inlet heater hose onto the engine block fitting.
9. Fill the cooling system, as described in Part 27-02 with the specified coolant mixture of 50/50 Ford Long Life Coolant ESE-M97B18-C (or equivalent) and water.
10. Test the system for proper heater performance with the specified engine cooling system conditions.

TESTING

PRESSURE TEST

Refer to Part 27-02, General Cooling System Service for pressure test procedure.

THERMOSTAT TEST

TRUCKS EQUIPPED WITH GASOLINE ENGINES

Remove the thermostat and immerse it in boiling water. Replace the thermostat if it does not open more than 1/4 inch.

If the problem being investigated is insufficient heat, the thermostat should be checked for leakage. This may be done by holding the thermostat up to a lighted background. Light leakage around the thermostat valve (thermostat at room temperature) is unacceptable and the thermostat should be replaced. It is possible, on some thermostats, that a slight leakage of light at one or two locations on the perimeter of the valve may be detected. This should be considered normal.

ADJUSTMENTS

BELT TENSION—GASOLINE ENGINES

BRONCO, E-100—E-350, F-100—F-350 SERIES TRUCKS

1. Install a belt tension gauge such as Rotunda models 210019 and 210020 or an equivalent, on the drive belt(s) (Fig. 1) and check the tension following the instructions of the tool manufacturer.
2. If adjustment is necessary, loosen the alternator mounting bolts and move the alternator adjusting arm bolt. Move the alternator toward or away from the engine until the correct tension is obtained, (See Specifications). Remove the gauge. Tighten the alternator adjusting arm bolt and the mounting bolts. Install the tension gauge and check the belt tension.

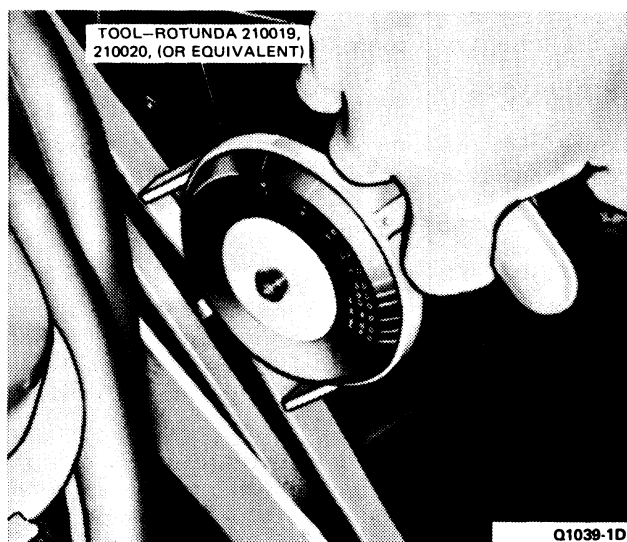


FIG. 1 Checking Drive Belt Tension

REMOVAL AND INSTALLATION

FAN

ALL WITH 6-CYLINDER ENGINES

Removal and Installation

1. Examine the fan mounting system to determine whether or not the drive belt tension should be relieved. Loosen fan drive belt(s) tension, if necessary.
2. If vehicle is equipped with shroud, remove shroud.
3. Remove the fan blade attaching bolts and remove the fan and spacer.
4. Position the spacer (if so equipped) and fan blade on the water pump hub or the crankshaft damper (low-mount fan). Tighten the attaching bolts.

5. Adjust fan belt(s) tension.

FAN BELT

Removal and Installation

1. Loosen the alternator mounting bolts and the alternator adjusting arm bolt. Move the alternator toward the engine. Remove the belt from the alternator, crankshaft pulley, and water pump pulley. Lift the belt(s) over the fan.
2. Place the belt(s) over the fan. Insert the belt(s) in the water pump pulley, crankshaft pulley, and alternator pulley grooves. Adjust the belt tension to specifications.

RADIATOR HOSE

Note: Collapsing radiator hoses (especially upper) may be an indication of a malfunctioning vacuum relief valve on radiator cap.

Removal and Installation

The cooling system hoses should be replaced whenever they become cracked or deteriorated, or have a tendency to collapse.

Partially drain the cooling system to replace a cooling system upper hose(s). Drain the cooling system to replace the radiator outlet hose.

1. Drain or partially drain the radiator, then loosen the clamps on each end of the hose(s) to be removed. Slide the hose(s) off the connections.
2. Position the clamps on each end of the new hose. Slide the hose onto the connections, then tighten the clamps. **If the connections have a bead around the edges, make sure the clamps are located beyond the beads.**
3. Fill the cooling system with coolant and bleed the system (Part 27-02).
4. Operate the engine for several minutes, then check the hose(s) and connections for leaks.

THERMOSTAT

Whenever changing the thermostat to a higher or lower temperature range on trucks equipped with automatic shutters, change the shutterstat accordingly to a higher or lower range.

A poppet-type thermostat is used with all engines.

When the thermostat is closed, coolant flows to the water pump through a by-pass passage at the front of the engine. When the thermostat is open, coolant flows through the coolant outlet elbow (thermostat housing) to the radiator.

The thermostat used in production is a high temperature thermostat for use with a mixture of water and permanent-type anti-freeze. A low temperature thermostat should be installed if a non-permanent type anti-freeze and water coolant solution is used (except on trucks with automatic radiator shutters).

Do not attempt to repair the thermostat. It should be replaced if it is not operating properly.

Check the thermostat before installing it, following the procedure under Testing: Thermostat Test.

6-CYLINDER ENGINES—GASOLINE

Removal

1. Drain the radiator so that the coolant level is below the thermostat.
2. Remove the coolant outlet elbow attaching bolts. Pull the elbow away from the cylinder head sufficiently to provide access to the thermostat. Remove the thermostat and gasket.

Installation

1. Clean the coolant outlet elbow and cylinder head gasket surfaces. Coat a new gasket with water-resistant sealer. Position the gasket on the cylinder

head opening. The gasket must be positioned on the cylinder head before the thermostat is installed.

2. The coolant outlet elbow contains a locking recess into which the thermostat is turned and locked. Install the thermostat with the bridge section in the outlet elbow. Turn the thermostat clockwise to lock it in position on the flats cast into the outlet elbow.
3. Position the coolant outlet elbow against the cylinder head. Install and tighten the attaching bolts to specifications (Group 21).
4. Fill and bleed the cooling system (Part 27-02). Check for leaks and proper coolant level after the engine has reached normal operating temperatures.

V-8 ENGINES—GASOLINE

Removal

1. Drain the radiator so that the coolant level is below the thermostat.
2. Disconnect the by-pass hoses at the water pump and intake manifold. Remove the by-pass tube. Remove the water outlet housing attaching bolts. Bend the radiator upper hose upward and remove the thermostat and gasket.

Installation

1. Clean the water outlet housing gasket surfaces. Coat a new water outlet housing gasket with water-resistant sealer. Position the water outlet housing gasket on the intake manifold opening.
2. Install the thermostat in the intake manifold opening with the copper pellet or element toward the engine and the thermostat flange positioned in the recess. If the thermostat is improperly installed, it will cause a retarded flow of coolant.
3. Position the water outlet housing against the intake manifold. Install and tighten the attaching bolts to specifications. Install the water by-pass line and tighten hose connections (Group 21).
4. Fill and bleed the cooling system (Part 27-02). Operate the engine until normal operating temperature is reached; then check the coolant level and check for leaks.

RADIATOR

The disconnect and connect points for radiators are shown in Figs. 2 through 5. **Attaching bolt and nut or fitting torques not given on the illustrations are found in Specifications in this Part.** Following are specific instructions covering unique operations. After the radiator is installed, fill and bleed the cooling system (Part 27-02).

RADIATOR SHROUDS

Fiberglass shrouds are attached to the radiator support with bolts having a flat washer, between the bolt head and the fiberglass. Always assemble the shroud to the support in this manner.

FITTINGS

Use a waterproof sealer when assembling fittings such as the drain cock to the radiator.

TRUCKS WITH AUTOMATIC TRANSMISSION

When installing a new radiator in a vehicle equipped with automatic transmission, transfer the oil cooler line fittings from the old radiator and install them in the new radiator, using oil resistant sealer.

When installation of the radiator is complete, check the oil cooler line connections for leaks. Check the transmission fluid level and add if necessary.

TRUCKS WITH COOLANT RECOVERY SYSTEM

On a vehicle with a coolant recovery system, remove the reservoir from the old radiator and install it on the new assembly.

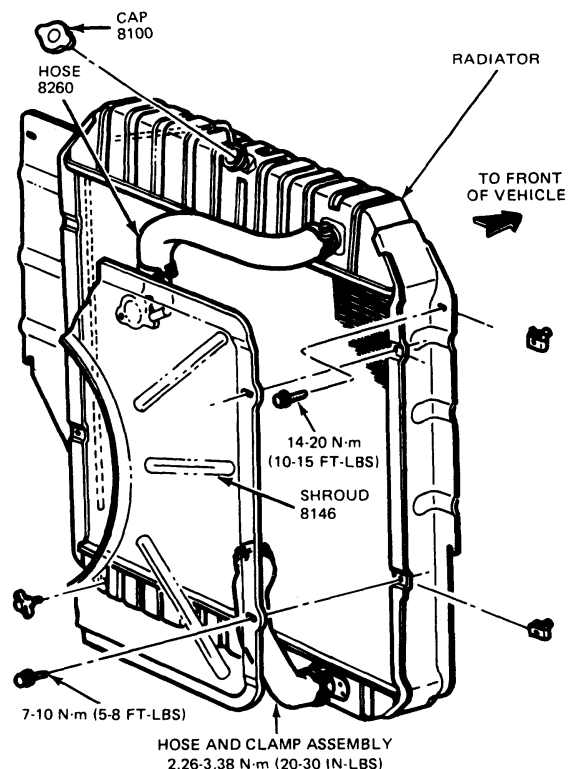
Completely fill the radiator through the filler cap in the radiator tank. The cap may be removed by turning it to the stop; then, push down on the cap and force it past the stop tangs on the filler neck. The engine should be running at idle speed to circulate the coolant and eliminate any trapped air in the system. Install the radiator cap. Fill the coolant reservoir (bottle) with one quart of coolant. Operate the vehicle until normal temperature is reached. Check the coolant reservoir to see if the coolant level is at the **Engine Hot** mark. If not, add coolant to the reservoir as required.

RADIATOR SUPPLY TANK

Removal

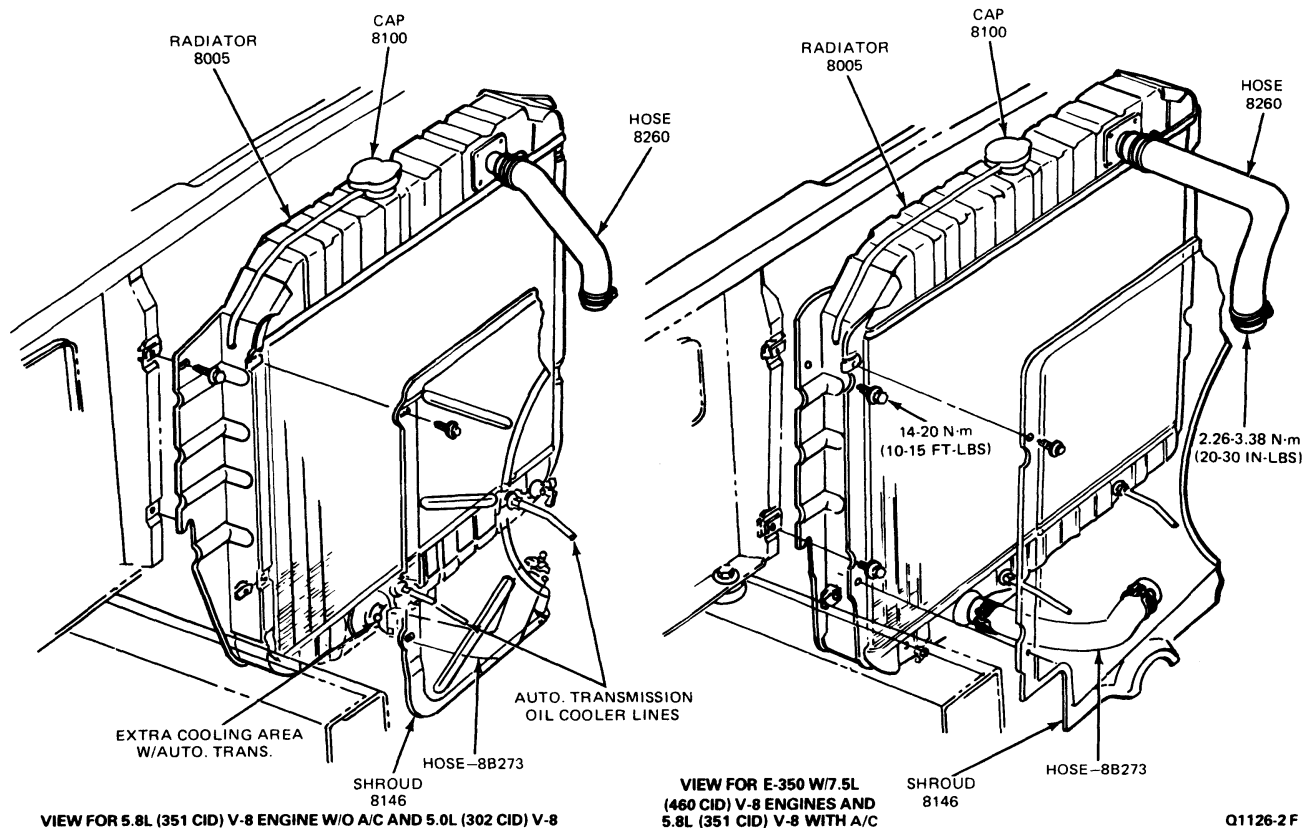
1. Drain the radiator until the coolant is out of the supply tank. Disconnect the radiator supply tank hose at the supply tank. Disconnect the radiator vent tube at the supply tank, if so equipped.

2. Remove the overflow tube from the supply tank. Remove the supply tank strap or bracket attaching bolt(s) and remove the supply tank.



Q1127-1 F

FIG. 3 Radiator Installation—E-100—E-350—6 Cylinder



Q1126-2 F

FIG. 2 Radiator Installation—E-100—E-350—8 Cylinder Engine

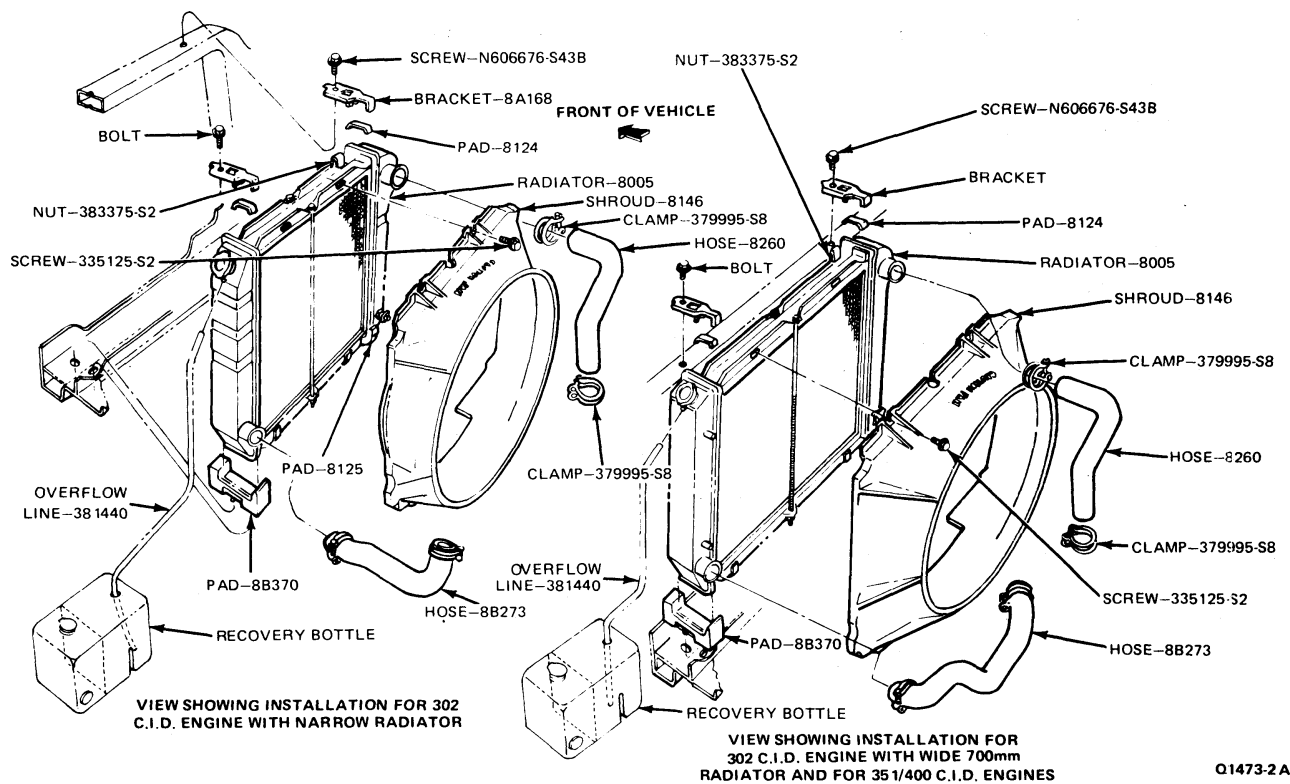


FIG. 4 Radiator Installation—Bronco and F-100—F-350—8 Cylinder Engine

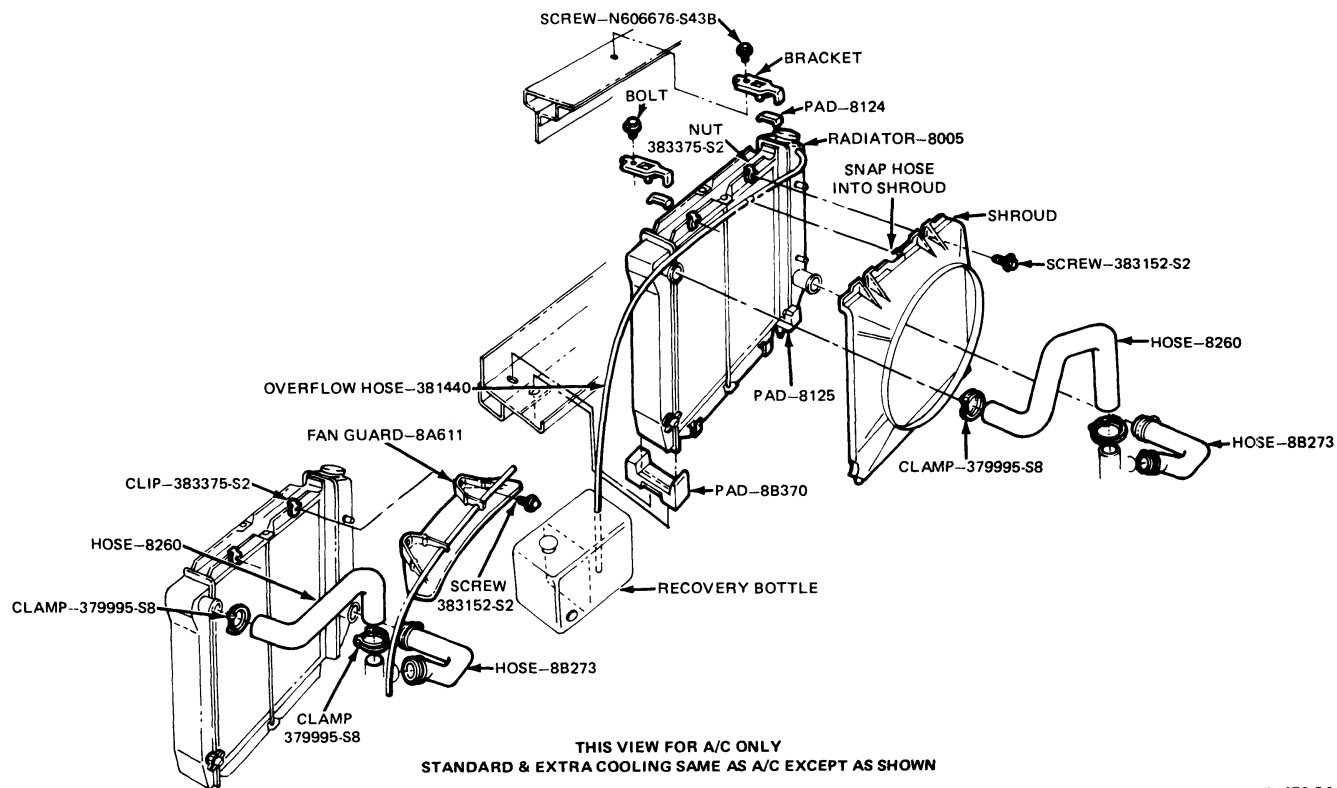


FIG. 5 Radiator Installation—F-100—F-350 and Bronco—6 Cylinder

Installation

1. Position the supply tank in the chassis and install the strap or bracket attaching bolt(s).
2. Connect the radiator hose, overflow tube and vent tube, (if so equipped), to the supply tank.
3. Fill and bleed the cooling system (Part 27-02). Check for coolant leaks and proper coolant level after the engine reaches normal operating temperatures.

CLEANING AND INSPECTION**COOLING SYSTEM**

To remove rust, sludge and other foreign material from the cooling system, use either Ford Regular Cooling System Cleanser or an equivalent, in severe cases, use Heavy Duty Cleanser. Removal of such material restores cooling efficiency and avoids overheating.

In severe cases where cleaning solvents will not properly clean the cooling system for efficient operation, it will be necessary to use the pressure flushing method.

Various types of flushing equipment are available. If pressure flushing is used, make sure the cylinder head

bolts are properly tightened to prevent possible water leakage into the cylinders.

Always remove the thermostat prior to pressure flushing.

A pulsating or reversed direction of flushing water flow will loosen sediment more quickly than a steady flow in the normal direction of coolant flow.

Do not backflush cooling systems that have a water shut-off valve in the heater system, or damage to the valve can result.

SPECIFICATIONS

TORQUE VALUES

Description	N•m (ft.-lbs.)	Description	N•m (ft.-lbs.)
Radiator to Body Sheet Metal E-100-E-350	14-20 (10-15)	Radiator Support to Frame Insulator Bolts	41-47 (30-35)
Radiator Hose Clamp Bronco, F-100-F-350, E-100-E-350	2.26-3.39 (20-30 in.-lbs.)	Fan to Water Pump Bronco, E-100-E-350, F-100-F-350	17-24 (12-18)
Water Outlet Housing 4.9L (300 CID) Six	17-20 (12-15)	Shroud to Radiator F-100-F-350, Bronco, E-100-E-350	7-10 (5-8)
5.0L (302 CID) V-8	17-20 (12-15)	Water Filter Hose Clip to Air Inlet Housing 3/8-16	28-33 (20-25)
5.8L (351 CID), V-8 Engines	32-37 (23-28)	Water Filter Hose Clip to Engine Idler Gear Cover 3/8-16	40-48 (29-36)
7.5L (460 CID)	32-37 (23-28)	Transmission Oil Line Fitting to Radiator — F-100-F-350 and Bronco	24-31 (18-23)
Radiator Top Brackets to Radiator Support F-100-F-350 and Bronco	11-14 (8-11)	Transmission Oil Line Nut to Fitting on Radiator — F-100-F-350 and Bronco	17-24 (12-18)
Radiator Hose Clamps F-100-F-350 and Bronco	2.25-3.38 (20-30 in.-lbs.)		

DRIVE BELT TENSION

Belt Width	Minimum Tension (for use at maintenance interval only) (Hot Engine)	Installation Tension	
		Used Belt ①	New Belt
1/4"	18 kg (40 lbs.)	18-27 kg (40-60 lbs.)	2.27-36.2 Kg 50-80 lbs.
3/8" and 15/32"	34 kg (75 lbs.)	40.8-54.4 kg (90-120 lbs.)	54.5-72.5 kg 120-160 lbs.
1/2"	34 kg (75 lbs.)	40.8-54.4 kg (90-120 lbs.)	54.5-72.5 kg 120-160 lbs.

COOLING SYSTEM PRESSURES (PSI)

	Operating Pressure	Min. Test Pressure
F-100-F-350, Bronco, E-100-E-350	13	10

① Any belt that has operated for ten minutes or more is considered a used belt.

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SPECIAL TOOLS

Number	Description
72002	Cooling System Pressurization Kit
210012	Cooling System Pressurization Kit
Rotunda 210019 or 210020	Belt Tension Gauge

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STARTING SYSTEM

GROUP
28
(11000)

<u>PART TITLE</u>	<u>PAGE NO.</u>	<u>PART TITLE</u>	<u>PAGE NO.</u>
Positive Engagement Starter	28-02-1	Starting System General Service	28-01-1

Starting System General Service

PART
28-01

APPLIES TO ALL MODELS

<u>SUBJECT</u>	<u>PAGE</u>	<u>SUBJECT</u>	<u>PAGE</u>
DIAGNOSIS GUIDES	28-01-2	GENERAL INFORMATION	28-01-1

GENERAL INFORMATION

The function of the starting system is to crank the engine at a speed fast enough to permit the engine to start. Heavy cables, connectors, and switches are used in the starting system because of the large amount of current required by the starter while it is cranking the engine. The amount of resistance in the starting circuit must be kept to an absolute minimum to provide maximum current for starter operation. Loose or corroded connections, relay contacts, or partially broken cables will result in slower than normal cranking speeds, and may even prevent the starter from cranking the engine.

In cases of starting system trouble, the owner may have discharged the battery before calling for

assistance. At the time the trouble occurs, the owner is more interested in getting the engine started than in knowing the cause of the trouble. A road service procedure is presented to aid the service technician in such cases of starting trouble. Once the engine is started, be sure to follow diagnosis procedures in order to locate the cause of the starting difficulty. The road service is not a part of the diagnosis procedures.

Refer to the Wiring Diagrams Manual for electrical schematic wiring diagrams and the locations of wiring harnesses.

DIAGNOSIS GUIDES

Use the following Diagnosis Guide to assist in locating the possible cause of any starter complaint that may occur.

CONDITION	POSSIBLE CAUSE	CORRECTION
Engine will not crank — starter spins.	- Starter motor. - Flywheel ring gear.	- Remove starter, inspect for broken or worn starter drive components. Repair or replace as required. - Inspect ring gear teeth. Replace flywheel and ring gear if necessary.
Engine will not crank.	- Loose or corroded battery cables. - Undercharged battery. - Burned fusible link in main wire feed to ignition switch. - Starter relay. - Loose or broken cables. - Loose or open wiring through neutral switch to relay. - Starter motor.	- Clean and tighten cable connections. - Check battery. Charge or replace. - Check fusible link — correct wiring problem. - Replace starter relay. - Tighten or replace cable. - Repair, adjust or replace as required. - Repair or replace as required.
Engine cranks slowly.	- Loose connections or corroded battery cables. - Undercharged battery. - Starter motor.	- Clean and tighten cable connections. - Check battery. Charge or replace. - Repair or replace as required.
No start in Neutral.	- Neutral start switch. - Steering column shifter components.	- Adjust or replace switch. - Inspect. Repair or replace as required.

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Positive Engagement Starter

**PART
28-02**

SUBJECT	PAGE	SUBJECT	PAGE
DESCRIPTION AND OPERATION	28-02-1	REMOVAL AND INSTALLATION	28-02-4
DISASSEMBLY AND ASSEMBLY	28-02-4	SPECIFICATIONS	28-02-7
Armature Replacement	28-02-7	TESTING	
Brush Replacement	28-02-6	Bench Tests	28-02-3
Starter Drive Replacement	28-02-6	On Vehicle Testing	28-02-2
		Road Service	28-02-1

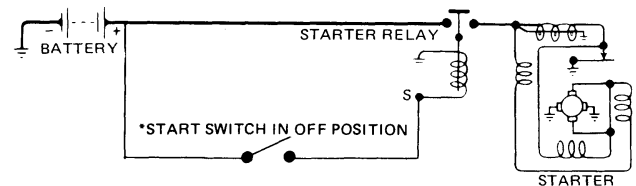
DESCRIPTION AND OPERATION

The starting system includes the starter motor with an integral positive-engagement drive, the battery, a remote control starter switch (part of the ignition switch), the neutral-start switch (used with automatic transmissions), the starter relay, and heavy circuit wiring (Fig. 1).

Turning the ignition key to the START position actuates the starter relay through the starter control circuit. The starter relay then connects the battery to the starter.

Vehicles equipped with an automatic transmission have a neutral-start switch in the starter control circuit. This prevents operation of the starter on vehicles with an automatic transmission if the selector lever is not in the N (neutral) or P (park) position.

When the starter is not in use, one of the field coils is connected directly to ground through a set of contacts (Fig. 1). When the starter is first connected to the battery current flows through the grounded field coil, actuating a movable pole shoe. The pole shoe is attached to the starter drive plunger lever and thus the drive is forced into engagement with the flywheel.



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FIG. 1 Starting Circuit

When the movable pole shoe is fully seated, it opens the field coil grounding contacts and the starter is then in normal operation. Normal field current is used to maintain the movable pole shoe in the fully seated position during the time that the starter is cranking the engine.

TESTING

ROAD SERVICE

On road service calls or cases of a starter that will not crank the engine or a starter that cranks very slowly, a booster battery may be connected to the 12-volt system. If the engine still will not turn with the booster connected, refer to the following tests.

NOTE: Improper use of a booster battery can result in personal injury and/or damage to the vehicle from battery explosion, acid or sparks. Also a booster not connected properly can damage electrical components in the vehicle or the components of the vehicle the booster battery is

in. This procedure and precautions should be strictly adhered to when using a booster.

1. Use only a battery of the same voltage as the vehicle being serviced.
2. Turn off all lights and electrical accessories before connecting the jumper cables. Make sure transmission is in neutral or park.
3. On a negatively grounded battery, shield eyes and connect a jumper cable to the positive (+) terminals of both batteries.
4. Connect one end of the other cable to the negative (-) terminal of the booster battery and then connect

the other end to the engine block or frame of the vehicle being serviced. Do not connect to the negative post of the discharged battery.

- When the engine starts, bring it to idle speed before removing the cables. Remove the end of the negative cable from the engine block (or frame) first to avoid arcing or sparks at the battery.

ON VEHICLE TESTING

IF STARTER CRANKS SLOWLY

- BATTERY**—Use jumper cables per instructions. If this corrects problem, check condition of battery, recharge or replace if necessary. Clean battery posts, cable lugs and tighten.
- CABLES**—If above does not correct problem, clean and tighten connections at starter, relay and battery ground on engine. Eyelet terminals should not be easily rotated by hand. Also check for short to ground.
- STARTER**—If above does not correct problem, replace starter.

IF STARTER DOES NOT CRANK BUT STARTER RELAY OPERATES (CLICKS)

- BATTERY**—Use jumper cables, check battery, etc as above.
- CABLE**—Clean and tighten connections at starter and relay. Make sure wire strands are secure in eyelets.
- STARTER**—If above does not correct problem, replace starter.

IF STARTER DOES NOT CRANK AND RELAY CHATTERS OR DOES NOT CLICK

- BATTERY**—Use jumper cables, check battery, etc. as above.
- RELAY**—Remove push-on connector from relay (red w/blue stripe wire) and make sure connection is

clean and secure. Make sure relay bracket is grounded.

If connections are good, check operation by jumping with push-on connection off and transmission in park or neutral. Jumper above described terminal to relay main terminal (BAT side) or battery positive post. If this corrects problem, check ignition switch, neutral switch and wiring in start circuit for open or loose connections.

If jumper across relay does not correct problem, replace relay.

IF STARTER SPINS (HUMMING NOISE) BUT DOES NOT CRANK ENGINE

STARTER—Remove and check armature shaft for corrosion, clean or replace. If no corrosion, drive assembly is slipping and must be replaced.

STARTER LOAD TEST

Conduct this test if the starter cranks slowly and a comparison of the current output with specifications is desired.

Connect the test equipment as shown in Fig. 2. Be sure that no current is flowing through the ammeter and heavy-duty carbon pile rheostat portion of the circuit (rheostat at maximum counterclockwise position).

Crank the engine with the ignition OFF, and determine the exact reading on the voltmeter. This test is accomplished by disconnecting the push-on connector "S" at the starter relay and by connecting the remote control starter switch from the positive battery terminal to the "S" terminal of the starter relay.

Stop cranking the engine. Then reduce the resistance of the carbon pile until the voltmeter indicates the same reading as that obtained while the starter cranked the engine. The ammeter will indicate the starter current draw under load. (Refer to Specifications.)

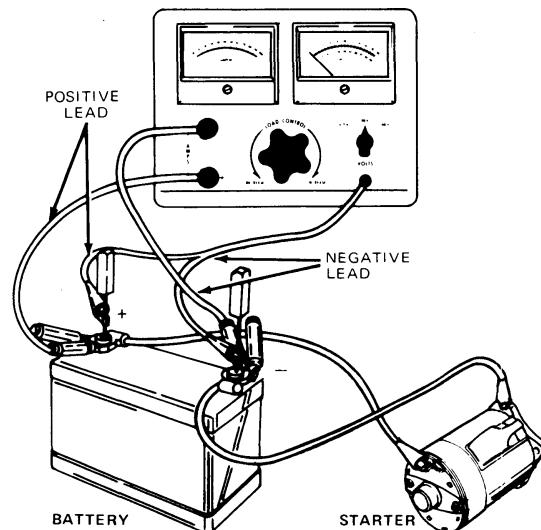
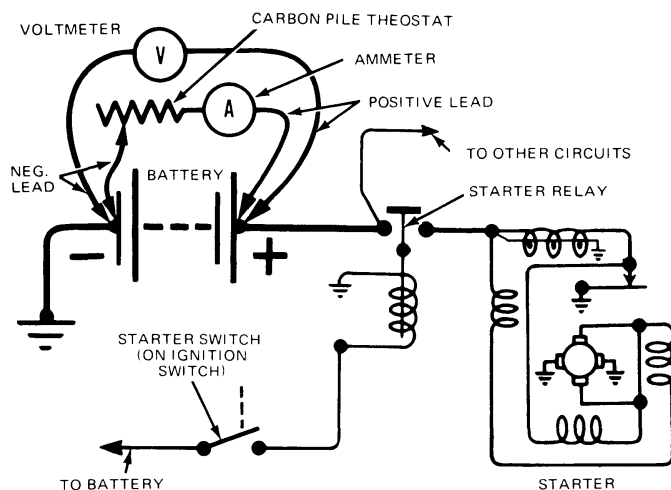


FIG. 2 Starter Load Test

BENCH TESTS

STARTER NO-LOAD TEST

The starter no-load test will uncover open or shorted windings, rubbing armature, and bent armature shaft. The starter can be tested, at no-load, on the test bench only.

Make the test connections as shown in Fig. 3. The starter will run at no-load. Be sure that no current is flowing through the ammeter (rheostat at maximum counterclockwise position). Determine the exact reading on the voltmeter.

Disconnect the starter from the battery. Then, reduce the resistance of the rheostat until the voltmeter indicates the same reading as that obtained while the starter was running. The ammeter will indicate the starter no-load current draw. (Refer to Specifications.)

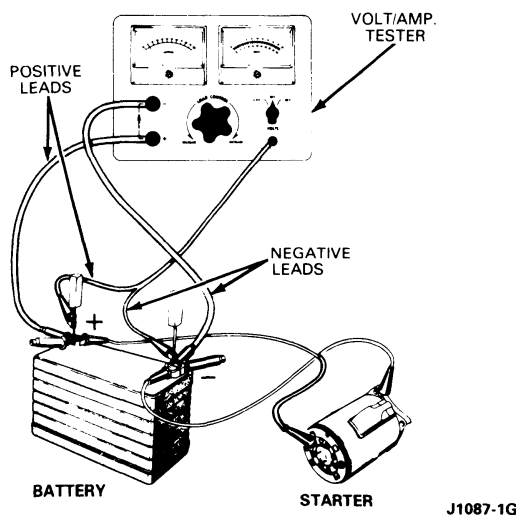


FIG. 3 Starter No-Load Test on Test Bench

ARMATURE OPEN CIRCUIT TEST

An open circuit armature may sometimes be detected by examining the commutator for evidence of burning. A spot burned on the commutator is caused by an arc formed every time the commutator segment, connected to the open circuit winding, passes under a brush.

ARMATURE AND FIELD GROUNDED CIRCUIT TEST

This test will determine if the winding insulation has been damaged, permitting a conductor to touch the frame or armature core.

To determine if the armature windings are grounded, make the connections as shown in Fig. 4. If the voltmeter indicates any voltage, the windings are grounded.

Grounded field windings can be detected by making the connections as shown in Fig. 5. If the voltmeter indicates any voltage, the field windings are grounded.

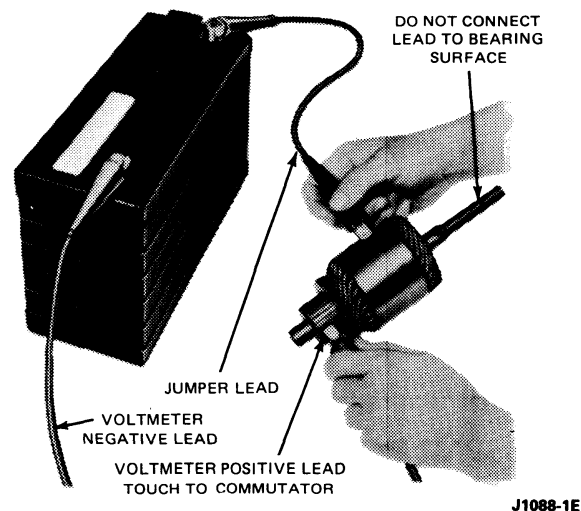


FIG. 4 Armature Grounded Circuit Test

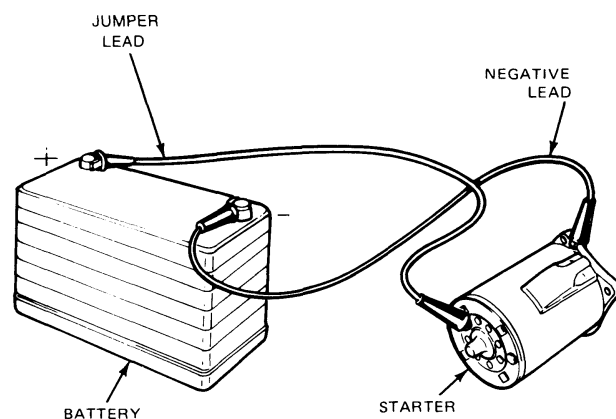


FIG. 5 Field Grounded Circuit Test

REMOVAL AND INSTALLATION

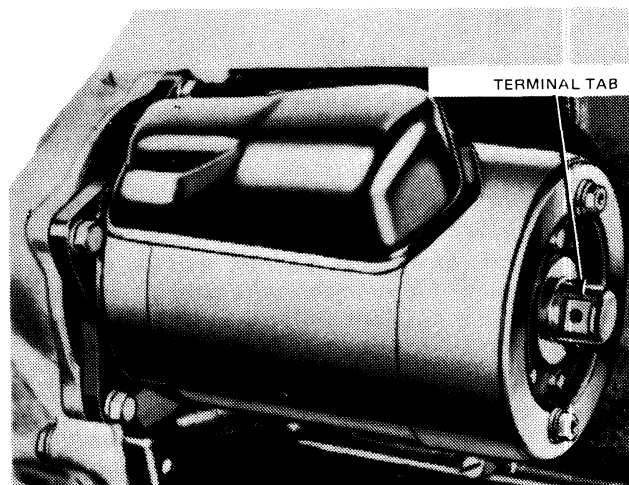
Removal

1. Disconnect the negative battery cable.
2. Raise the vehicle on a hoist.
3. Disconnect the starter cable at the starter terminal.
4. Remove the starter mounting bolts. Remove the starter assembly (Fig. 6).

Installation

1. Position the starter assembly to the flywheel housing, and start the mounting bolts.
2. Snug all bolts while holding the starter squarely against its mounting surface and fully inserted into the pilot hole. Tighten the bolts to 21-27 N·m (15-20 ft-lbs).

3. Connect the starter cable.
4. Lower the vehicle. Connect negative battery cable to battery. Check the operation of the starter.



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FIG. 6 Starter Mounting

DISASSEMBLY AND ASSEMBLY

Use the following procedure when it becomes necessary to completely overhaul the starter. Figs. 7 and 8 illustrate a disassembled starter.

Disassembly

1. Remove the cover screw, cover through bolts,

starter drive end housing, and the starter drive plunger lever return spring.

2. Remove the pivot pin retaining the starter gear plunger lever and remove the lever and the armature.

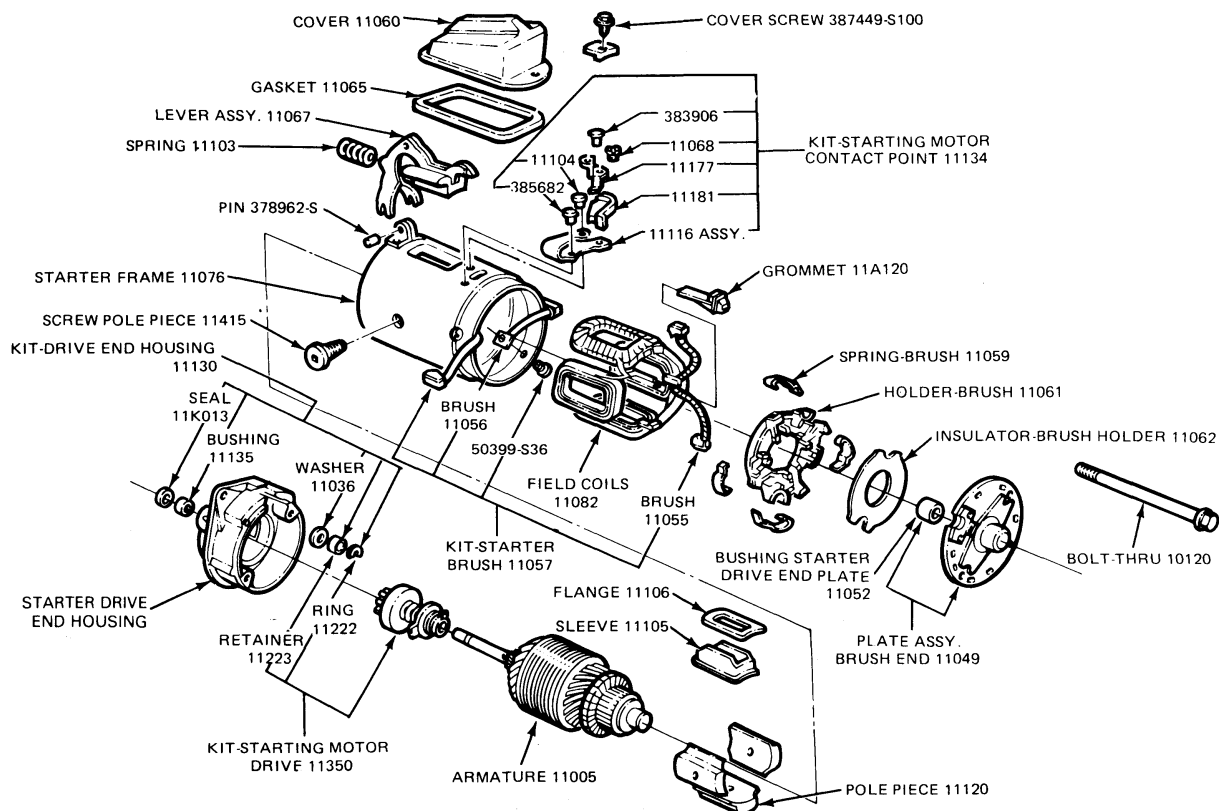
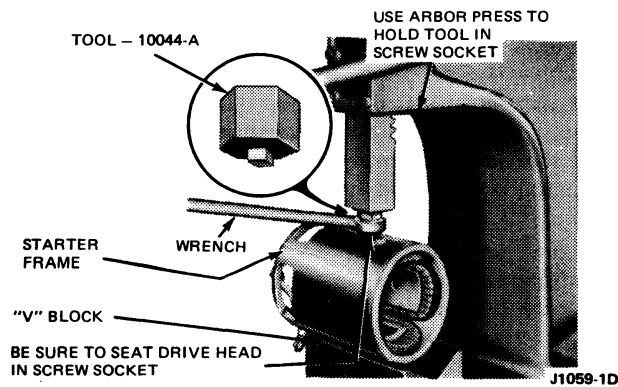


FIG. 7 Starter Disassembled

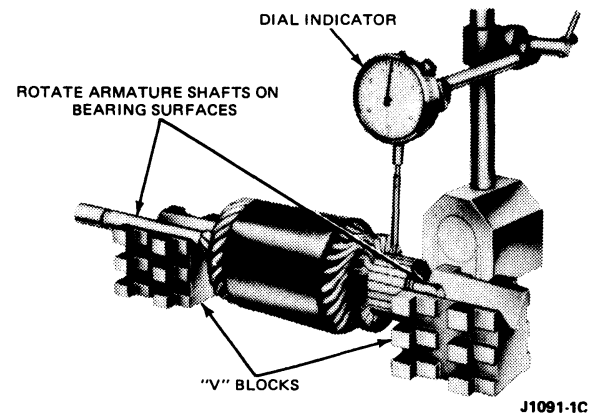
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**FIG. 8 Pole Shoe Screw Removal**

3. Remove the stop ring retainer. Remove and discard the stop ring retaining the starter drive gear to the end of the armature shaft, and remove the starter drive gear assembly.
4. Remove the brush end plate and insulator assembly.
5. Remove brushes from plastic brush holder and lift out brush holder. Note location of brush holder with respect to end terminal.
6. Remove the two screws retaining the ground brushes to frame.
7. On the field coil that operates the starter drive gear actuating lever, bend the edges on the field coil retaining sleeve and remove the sleeve and retainer.
8. Remove the three coil retaining screws using Tool 10044-A or equivalent and an arbor press (Fig. 8). The arbor press prevents the wrench from slipping out the screw. Cut the field coil connection at the switch post lead and remove small diameter ground wire from upper tab riveted to frame. Remove pole shoes and coils from frame.
9. Cut the positive brush leads from the field coils, as close to the field connection point as possible.

Cleaning and Inspection

1. Use a brush or air to clean the field coils, armature, commutator, armature shaft, brush end plate, and drive end housing. Wash all other parts in solvent and dry the parts.
2. Inspect the armature windings for broken or burned insulation and unsoldered or open connections.
3. Check the armature for open circuits and grounds.
4. Check the commutator for runout (Fig. 9). Inspect the armature shaft and the two bearings for scoring and excessive wear. If the commutator is rough, or more than 0.005 inch out-of-round, turn it down.
5. Check the plastic brush holder for cracks or broken mounting pads. Replace the brushes if worn to 1/4 inch in length. Check the field brush connections. A brush kit and contact kit are available. All other assemblies are to be replaced rather than repaired.
6. Examine the wear pattern on the starter drive teeth. The pinion teeth must penetrate to a depth greater

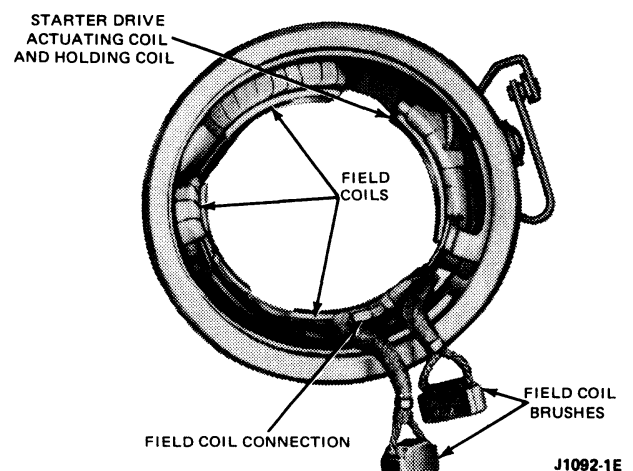
**FIG. 9 Commutator Runout Check**

than 1/2 the ring gear tooth depth (Fig. 11), to eliminate premature ring gear and starter drive failure.

7. Replace starter drives and ring gears having milled, pitted or broken teeth or that show evidence of inadequate engagement (Fig. 11).

Assembly

1. Position the three coils and pole pieces, then install the attaching screws (Fig. 7). As the pole shoe screws are tightened, strike the frame several sharp blows with a soft-faced hammer to seat and align the pole shoes, then stake the screws.
2. Install the remaining coil and retainer and bend the tabs to secure the coils to the frame.
3. Position the new insulated field brushes lead on the field coil terminal. Install the clip provided with the brushes to hold the brush lead to the terminal. Solder the lead, clip, and terminal together, using rosin core solder (Fig. 10). Use a 300-watt iron.

**FIG. 10 Field Coil Assembly**

4. Check for continuity and grounds in the assembled coils.
5. The coil which is around the retaining sleeve is to be grounded by positioning the small diameter wire leading from it, under the copper tab held by the rivet which attaches the contact to the frame.

6. Attach the ground brushes to the starter frame with the screws (Fig. 10).
7. Apply a thin coating of Lubriplate 777 or equivalent on the armature shaft splines. Install the starter motor drive gear assembly to the armature shaft and install a new retaining stop ring. Install a new stop retainer.
8. Install the armature in the starter frame.
9. Partially fill the drive end housing bearing bore with grease (approximately 1/4 full). Position the starter drive gear plunger lever to the frame and starter drive assembly, and install the pivot pin.
10. Position the starter drive plunger lever return spring and the drive end housing to the frame. Install brush holder, insert brushes and springs. Install brush holder insulator.
11. Position end plate to frame, align plate locator with frame slot. Install and tighten the through bolts to specification. Do not pinch brush leads when installing end plate.
12. Position the drive gear plunger lever cover on the starter and fasten with the cover screw in the frame.
13. Check the starter no-load current draw.

STARTER DRIVE REPLACEMENT

1. Remove the starter drive plunger cover (Fig. 7).
2. Loosen the through bolts enough to allow removal of the drive end housing and the starter drive plunger lever return spring.
3. Remove the pivot pin retaining the starter drive plunger lever and remove the lever.

4. Remove the drive gear stop ring retainer and stop ring from the end of the armature shaft and remove the drive gear assembly.
5. Apply a thin coating of Lubriplate 777, or equivalent on the armature shaft splines. Install the drive gear assembly on the armature shaft and install a new stop ring.
6. Position the starter gear plunger lever on the starter frame and install the pivot pin. **Be sure that the plunger lever properly engages the starter drive assembly.**
7. Install a new stop-ring retainer. Partially fill the drive end housing bearing bore with grease (approximately 1/4 full). Position the starter drive plunger lever return spring and drive end housing to the starter frame, and then tighten the through bolts to 6.21-8.47 N·m (55-75 in-lbs).
8. Position the starter drive plunger lever cover with its gasket, on the starter. Tighten the attaching screw.

BRUSH REPLACEMENT

Replace the starter brushes when they are worn to 1/4 inch. Always install a complete set of new brushes.

1. Remove the two through bolts from the starter frame.
2. Remove the brush end plate, brush springs and brushes from the holder.
3. Remove the ground brush attaching screws from the frame and remove the brushes.
4. Cut the insulated brush leads from the field coils, as close to the field connection point as possible.

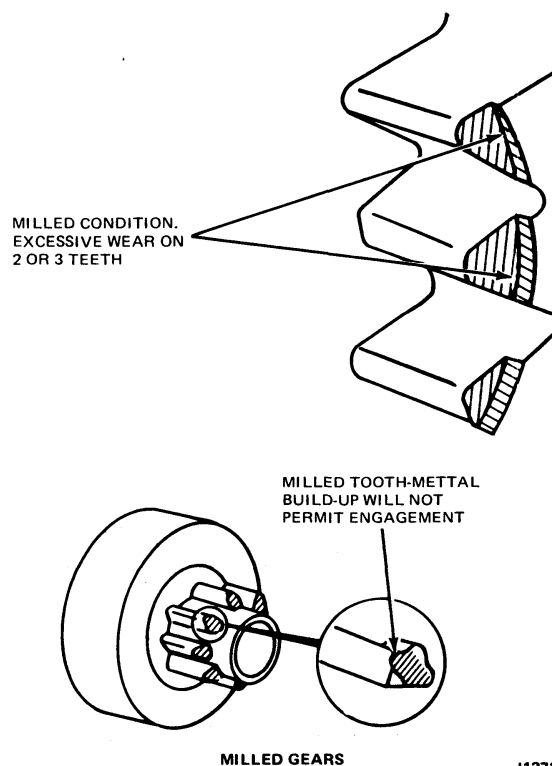
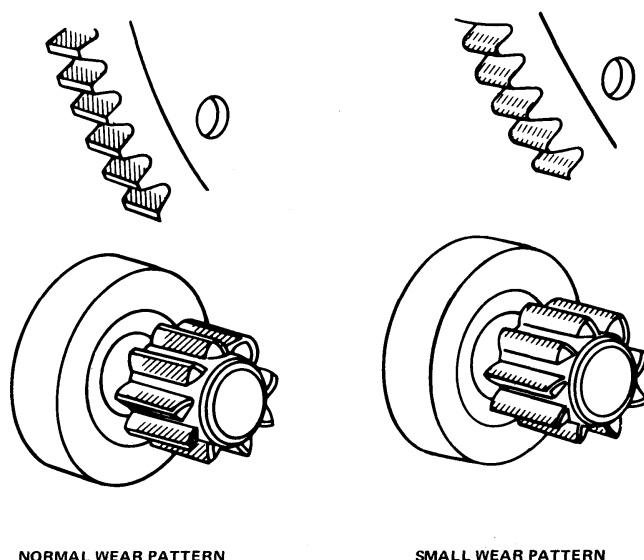


FIG. 11 Pinion and Ring Gear Wear Patterns

5. Check the plastic brush holder for cracks or broken mounting pads. Replace if necessary.
 6. Position the new insulated field brushes lead on the field coil connection. Position and crimp the clip provided with the brushes to hold the brush lead to the connection. Solder the lead, clip, and connection together, using rosin core solder (Fig. 10). Use a 300-watt iron.
 7. Install the ground brush leads to the frame with the attaching screws.
 8. Install brush holder and insert brushes in holder and install brush springs. Positive brush leads should be positioned in their respective slots in the brush holder to prevent potential grounding.
 9. Install the brush end plate. Be sure end plate insulator is positioned properly on the end plate.
 10. Install the two through bolts to the starter frame and tighten to 6.21-8.47 N·m (55-75 in-lbs).
 11. Connect the starter to a battery to check its operation.
- ARMATURE REPLACEMENT**
1. Remove starter drive plunger lever cover retainer screw and remove cover.
 2. Remove the through bolts, the drive end housing, and the drive plunger lever return spring, brush end plate.
 3. Remove the pivot pin retaining the starter gear plunger lever, and remove the lever. Remove brushes and lift out brush holder.
 4. Remove the armature. If the starter drive gear assembly is being reused, remove the stop ring from the end of the armature shaft, and remove the drive.
 5. Place the drive gear assembly on the new armature with a new stop ring.
 6. Install the armature in the starter frame.
 7. Position the drive gear plunger lever to the frame and drive gear assembly and install the pivot pin.
 8. Partially fill the drive end housing bearing bore with grease (approximately 1/4 full). Position the drive plunger lever return spring, the drive end housing to the starter frame. Be sure that the stop ring retainer is seated properly in the drive housing.
 9. Install brush holder and insert brushes in holder and install brush springs. Positive brush leads should be positioned in their respective slots to prevent grounding.
 10. Install the brush end plate (be certain end plate insulator is positioned properly on end plate).
 11. Install the two thru bolts to the starter frame and tighten to 6.21-8.47 N·m (55-75 in-lbs).
 12. Install starter drive plunger lever cover and tighten retaining screw.
 13. Check the starter no-load current draw.

SPECIFICATIONS

POSITIVE ENGAGEMENT STARTER

Positive Engagement Starter Motor				Starter Brushes			Through Bolt Torque (in-lbs) N·m	Mounting Bolt Torque (ft-lbs) N·m
Dia. (Inches)	Current Draw Under Normal Load (Amps)	Normal Engine Cranking Speed (rpm)	Current Draw No. Load (Amps)	Mfg. Length (Inches) mm	Wear Limit (Inches) mm	Spring Tension (Ounces) kg		
4	150-200	180-250	70	12.2 (0.50)	6.35 (0.25)	1.134 (40)	6.21-8.47 55-75	21-27 (15-20)
4-1/2	150-180	150-290	80	12.2 (0.50)	22.68 (0.25)	1.134 (80)	6.21-8.47 55-75	21-27 (15-20)

Maximum Commutator runout is 0.005 inch. Maximum starting circuit voltage drop (battery positive terminal to starter terminal) at normal engine temperature is 0.5 volt.

Tool No.	Former No.	Description
TOOL 10044-A	10044-A	Generator Pole Screw Wrench

ENGINE EMISSION CONTROL SYSTEMS

GROUP 29

PART TITLE	PART NO.	PART TITLE	PART NO.
Engine Emission Control Systems	29-01	Light Duty and Heavy Duty Truck	
Exhaust Gas Recirculation System	29-07	Engine Diagnosis and Service	29-02
		Thermactor System	29-03

Engine Emission Control Systems

PART 29-01

APPLIES TO ALL MODELS

SUBJECT	PAGE	SUBJECT	PAGE
GENERAL INFORMATION		GENERAL INFORMATION (Cont'd.)	
Emission — Related Fuel System		Vacuum Delay Valves	
Components	29-01-1	(SDV — Spark Delay Valve) —	
Emission — System Control		(RDV — Retard Delay Valve)	29-01-3
Components	29-01-3	Identification	29-01-1
PCV Valve and Crankcase		System Description	29-01-2
Vent Cap	29-01-3	MAINTENANCE OPERATION	
PVS (Ported Vacuum Switch)	29-01-3	Cleaning PCV System	29-01-5
		Replacing PCV Valve	29-01-4
		SPECIFICATIONS	29-01-5
		TESTING AND ADJUSTMENT	29-01-4

GENERAL INFORMATION

The Engine Emission Control Systems section of the Ford Truck Shop Manual is designed to cover those adjustments and service operations required to meet factory specifications.

IDENTIFICATION

Five maintenance schedules are specified for the 1980 Model Bronco, Econoline (E-100 through E-350) and F-Series Trucks. They are identified by the letters B and E.

The maintenance schedule you must follow is determined by the GVWR of your vehicle and whether it was sold in the U.S. or Canada. Vehicles sold in the U.S. will use the "B" schedule if the GVWR is 8500 pounds or less and the "E" schedule if the GVWR is over 8500 pounds. Vehicles sold in Canada will use the "B" schedule if the GVWR is 6000 pounds or less and

the "E" schedule if the GVWR is over 6000 pounds (Fig. 1).

1980 VECI decals for California vehicles also include a schematic drawing showing emission related vacuum connections.

EMISSION-RELATED FUEL SYSTEM COMPONENTS

ELECTRIC ASSISTED CHOKE

Some light trucks use an electrically-heated choke thermostatic spring housing as an aid to fast choke release and better emission characteristics during engine warm-up (Fig. 2). The heater operates from the center tap of the alternator, **only when the engine is actually running.**

The electric choke system consists of a choke cap, thermostatic spring, a bimetal temperature sensing disc

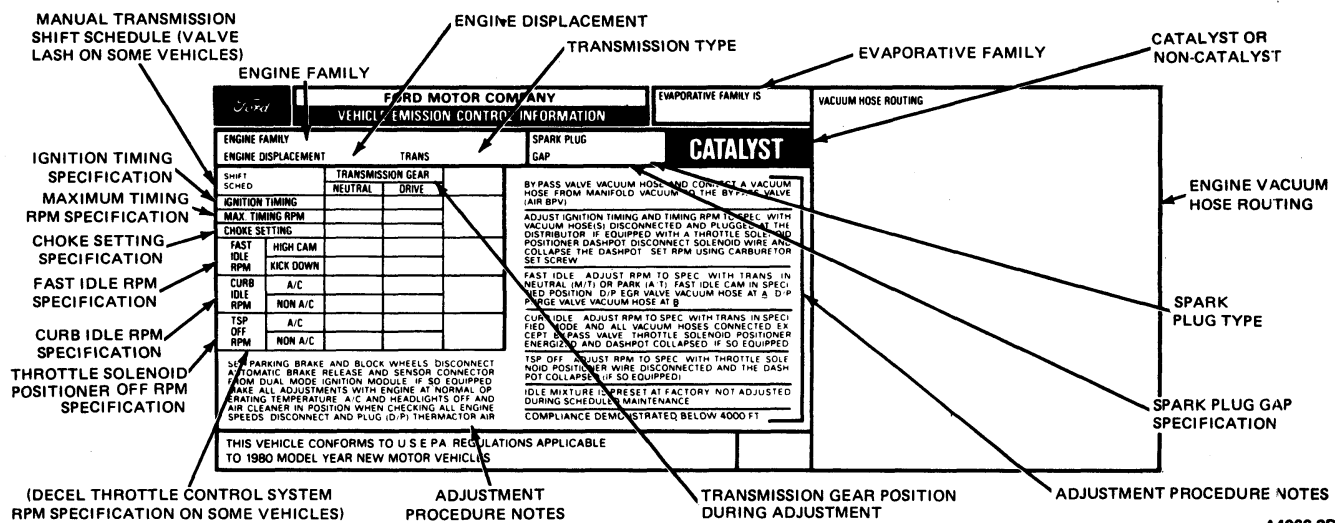


FIG. 1 Typical Vehicle Emission Control Information Decal

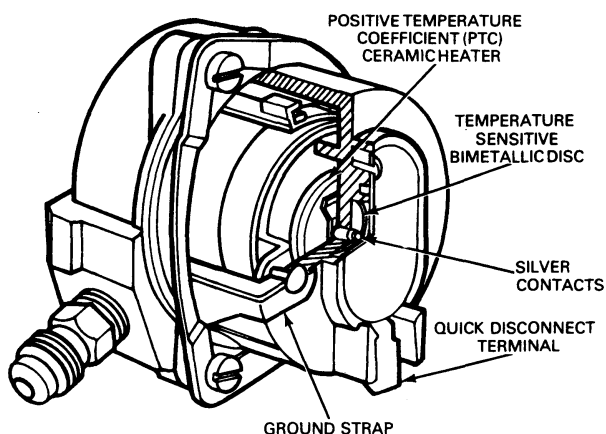


FIG. 2 Electric Assisted Choke

(switch), and a ceramic positive temperature coefficient (PTC) heater (Fig. 2). The choke is powered from the center tap of the alternator (Fig. 3). Current is constantly supplied to the temperature sensing switch. The system is grounded through a ground strap connected to the carburetor body.

ELECTRIC CHOKE SYSTEM—TYPICAL

The electric choke system is an aid in reducing vehicle exhaust emissions by matching choke operation to engine requirements throughout a wider range of conditions. The electric choke consists of an engine temperature sensing control switch connected in series with a positive temperature coefficient (PTC) ceramic

heater. The switch/heater device is intended to optimize choke function depending upon "soak" temperature, length of "soak" and prior vehicle operation/parking conditions. Vehicle cold driveway requirements vary depending upon the overall vehicle operating temperature. The electric choke heater and switch are intended to satisfy these requirements by:

- Allowing increased choke enrichment (no heating) after low temperature soaks of sufficient length to reduce engine temperature to ambient temperature.
- Providing reduced choke enrichment (heating) when the vehicle has:
 - soaked in low ambients for a period of time that is not sufficient to reduce engine temperatures below switching temperatures.
 - not soaked at ambients below the switching temperature.

SYSTEM DESCRIPTION

SENSING CONDITIONS

The engine temperature sensing control switch senses the temperature of the gases surrounding the bimetal. This temperature sensed is the manifold heated choke hot air supply used to operate the bimetallic choke control thermostat. Calibration of the choke to this temperature gradient correlates well to the engine choking requirements during all ambient warm-up.

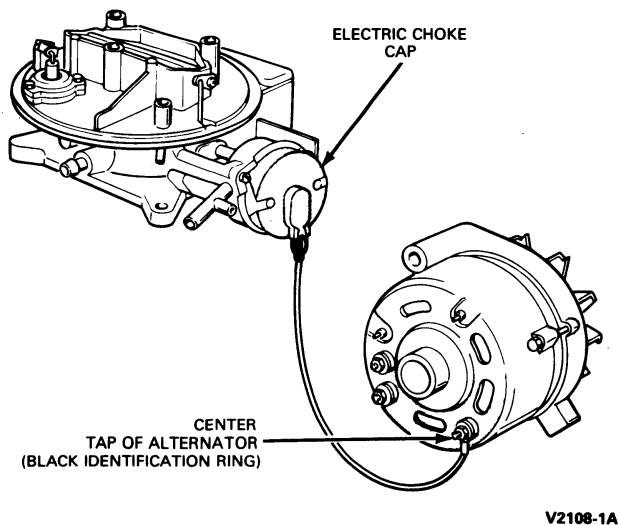
SWITCH OPERATION

- The switch will be open below 54° F (12° C).
- The switch will be closed above 74° F (23° C).

- Between 54°F (12°C) and 74°F (23°C), the switch may be either open or closed (depending on prior mode).

SWITCH FUNCTION

The switch supplies current to a positive temperature coefficient (PTC) heater which decreases choke come off time by increasing the temperature inside the choke cap and, hence, the bimetallic choke control thermostat. The system allows the choke calibration to be more closely tailored to the engine starting and warm-up requirements.



V2108-1A

FIG. 3 Electric Choke Wiring—Typical

CARBURETOR IDLE MIXTURE AND SPEED ADJUSTMENTS

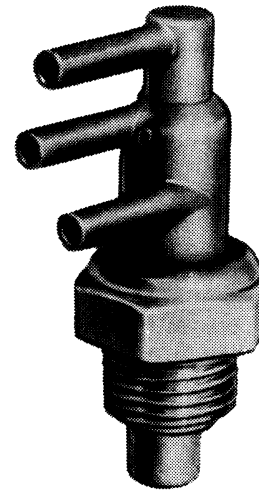
Most carburetor adjustments are factory set, and based on guidelines determined for reduced engine emission. Specifications for carburetors are listed in the Performance Specifications book and adjustments are covered under "ADJUSTMENTS—Carburetor" in Part 50-29 of the Pre-Delivery, Maintenance and Lubrication Manual.

EMISSION-SYSTEM CONTROL COMPONENTS

PVS (PORTED VACUUM SWITCH)

These switches are used in several places in the emission control systems. Used with two, three or four ports, the valves can be used to turn vacuum on and off, or to switch between two vacuum sources for a third delivery point (Fig. 4).

When cold, the typical three-port PVS provides a path through the center and top holes. When hot, the top port is closed off and the center and bottom ports are connected. In the case of the cooling PVS, the distributor vacuum advance diaphragm normally receives its vacuum signal from the carburetor spark port. If the engine should overheat while idling, the PVS connects the distributor to full intake manifold vacuum, thus increasing the engine speed until cool-down occurs. When the engine temperature drops, the PVS once again connects the distributor to the spark port.

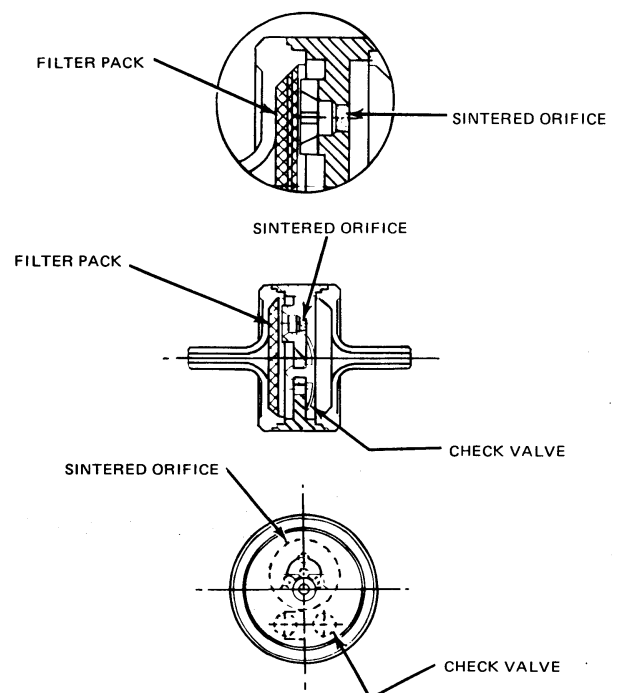


B3104-1A

FIG. 4 Ported Vacuum Switch (PVS)

VACUUM DELAY VALVES (SDV-SPARK DELAY VALVE) (RDV-RETARD DELAY VALVE)

Delay valves are found in many locations on the 1980 engines. Basically, the delay valve works to slow air flow in the vacuum lines, thus providing time delay control on vacuum operated equipment. The SDV is normally used to delay the opening function of a vacuum device during mild acceleration and RDV is used to delay the closing of a vacuum device during deceleration. **All Delay Valves have a specified time delay controlled by a porous sintered metal orifice, a check valve, and a filter pack.** Delay valves are directional and must be installed in the proper direction in each system (Fig. 5).



V1826-1A

FIG. 5 Spark Delay Valve (SDV)

PCV VALVE AND CRANKCASE VENT CAP

The Ford Crankcase Emission Control System is a closed ventilation system that is designed to prevent crankcase fumes or combustion gases from escaping through the engine oil filler or breather cap to the atmosphere. The crankcase control system controls these fumes or vapors ("blowby") by directing them back into the intake manifold where they are consumed in the normal combustion process (Fig. 6).

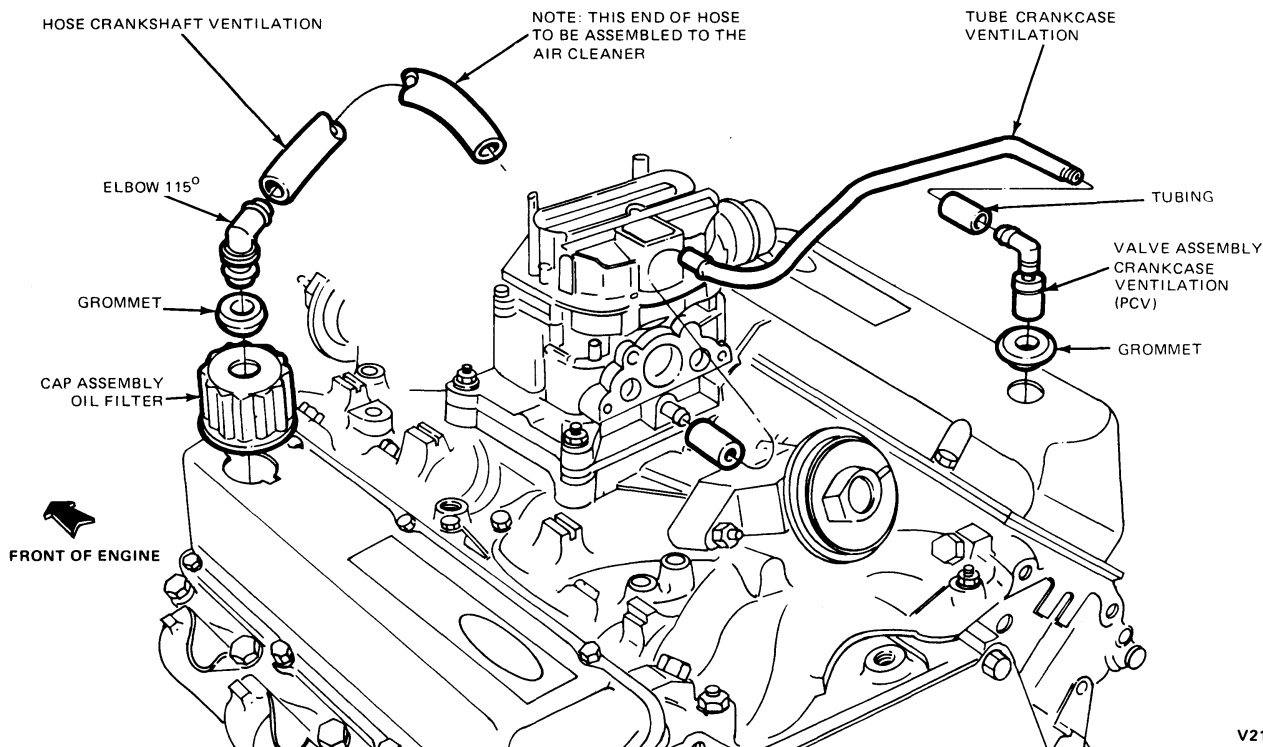
The crankcase ventilating air source is the carburetor air cleaner. The air passes through a filter located in the air cleaner and then through a hose connecting the air cleaner to the oil filler cap. The air filler cap is sealed at the filler opening to prevent the entrance of atmospheric air. From the oil filler cap, the air flows into the rocker arm chamber. The ventilating air moves down past the push rods into the lower crankcase. The air and crankcase gas mixture flows from the crankcase through a flow-regulating valve (PCV valve) into the intake manifold through the crankcase vent hose, tube and fittings. The ventilation process goes on continuously while the engine is running. Periodic maintenance is

required to keep system operating properly. Refer to PCV system diagnosis, testing service and cleaning in Part 29-02 of this manual and Part 50-29 of the Pre-Delivery, Maintenance and Lubrication Manual.

EXHAUST HEAT CONTROL VALVE—SPRING OPERATED (4.9L (300 CID) I-6 6 CYL. U/10,000 GVW)

If fuel condenses on the cold surfaces of the induction system, air-fuel ratios fluctuate. These variations can cause uneven acceleration and increased emission levels. The exhaust control valve used on some engines is designed to provide quick induction system warm-up and better cold engine air-fuel ratio control. The thermostatically controlled valve is located in the exhaust manifold.

While the engine is cold, the valve is closed and routes hot exhaust gas through a passage under the carburetor. This quickly warms the air-fuel mixture delivery passages, thus providing improved air-fuel ratio control. As the engine warms up and the valve opens, this action reduces exhaust gas flow through the warm-up passage to prevent excessive heat.



V2163-2B

FIG. 6 PCV System—7.5L (460 CID) 4-V V-8 Engine Shown—Others Similar

TESTING AND ADJUSTMENT

Refer to Part 50-29, in the Pre-Delivery, Maintenance and Lubrication Manual, and Part 29-02 in this manual for testing and adjustment procedures.

MAINTENANCE OPERATION

REPLACING PCV VALVE

Two types of PCV valves are provided for service replacement. These are a standard flow and a high flow valve. Some vehicles will require the high flow valve when they have accumulated 22,500 or more miles. Vehicles having this requirement are designated "PCV", following the Engine Family information in the upper left box of the Vehicle Emission Control Information decal attached to the engine (Fig. 1). The exact mileage interval and the specific replacement valve for the vehicle is indicated at the lower right area of the decal.

On all vehicles that do not show a PCV designation on the Emission Control decal, the standard flow valve is used when replacement is necessary.

NOTE: When a PCV valve is replaced on a vehicle with accumulated mileage the curb idle speed will change due to a leaner mixture and must be checked and adjusted. On those vehicles with the "PCV" designation on the decal, the curb idle and artificial enrichment idle mixture specifications are specified on the decal. On vehicles without the PCV designation, adjust the

curb idle to the specified rpm on the decal. The procedures for these adjustments are in Part 29-02, SSD-13 and SSD-26 in this manual and the Pre-Delivery, Maintenance and Lubrication Manual, Part 50-29 Fuel Subsystem.

1. Disconnect hose(s) and remove PCV valve.

NOTE:

- A. If a high flow PCV valve is scheduled for installation, consult the Vehicle Emission Control Information Decal for the correct high flow PCV valve part number.
 - B. If replacement PCV valve requires a plastic fitting for additional vacuum lines, soak the new plastic fitting (furnished in PCV valve replacement kit) in hot water prior to installing on new PCV valve. Proceed to Step 2.
2. Install new PCV valve and connect hose(s).
 3. Check curb idle speed in accordance with Procedure D-2 in Part 29-02.

CLEANING PCV SYSTEM

Refer to Part 29-02 (SSD-11) in this manual.

SPECIFICATIONS

Refer to the 1980 Truck Performance Specifications Book for engine component adjustment specifications.

Light Duty and Heavy Duty Truck Engine Diagnosis and Service

PART 29-02

SUBJECT	PAGE	SUBJECT	PAGE
DIAGNOSIS CHARTS			
Routine 101 Engine Will Not Crank — Starter Spins . . .	29-02-2	Routine 121 Engine Diesels — Continues To Run After Shut Off	29-02-43
Routine 102 Engine Will Not Crank	29-02-3	Routine 122 Engine Noise	29-02-45
Routine 103 Engine Cranks Slowly	29-02-5	Routine 122A Spark Knock Or Pinging	29-02-46
Routine 104 Engine Cranks Normally — Will Not Start	29-02-6	Routine 123 Engine Vibration	29-02-49
Routine 105 Engine Cranks Normally — Starts Hard When Cold . . .	29-02-8	Routine 124 Engine Fails To Reach Normal Operating Temperature	29-02-50
Routine 106 Engine Cranks Normally — Starts Hard When Hot . . .	29-02-10	Routine 125 Loss of Coolant Or Engine Overheats	29-02-51
Routine 107 Engine Idles Rough — Misses	29-02-12	Routine 126 Smoke From Vehicle Exhaust System	29-02-53
Routine 108 Engine Idle Speed Varies	29-02-15	Routine 129 Gasoline Odor Present	29-02-55
Routine 108A Engine Idle Speed is High	29-02-17	DIAGNOSTIC CHART REFERENCE ONE	29-02-56
Routine 109 Engine Misses At High Speed	29-02-19	DIAGNOSTIC CHART REFERENCE TWO	29-02-57
Routine 110 Engine Misses At Low Speed	29-02-21	EMISSION CONTROL SYSTEM DIAGNOSIS AND SERVICE PROCEDURES	
Routine 111 Engine Stalls At Idle — Engine Cold	29-02-23	SSD- 1 EGR System	29-02-60
Routine 112 Engine Stalls At Idle — Engine Hot	29-02-25	SSD- 2 Vacuum Delay Valves	29-02-64
Routine 113 Engine Stalls During Deceleration or On Quick Stops	29-02-27	SSD- 3 PVS Functional Check	29-02-65
Routine 114 Engine Hesitates — Stalls During Acceleration	29-02-29	SSD- 4 Thermactor System — Non-Catalytic	29-02-66
Routine 115 Engine Has Poor Acceleration	29-02-31	SSD- 5 Thermactor System — Catalytic	29-02-69
Routine 116 Engine Has Less Than Normal Power	29-02-33	SSD- 6 Carburetor Icing	29-02-76
Routine 117 Exhaust System Backfire	29-02-36	SSD- 9 Air Cleaner Temperature Control Systems	29-02-76
Routine 118 Engine Surges	29-02-37	SSD-10 Exhaust Heat Control Valve	29-02-79
Routine 119 Excessive Fuel Consumption	29-02-39	SSD-11 PCV System	29-02-79
Routine 120 Excessive Oil Consumption	29-02-41	SSD-12 Automatic (D-3) Choke Systems	29-02-79
		SSD-13 Idle Fuel Mixture	29-02-79
		SSD-14 Ignition System	29-02-83
		SSD-15 Ignition Timing	29-02-90
		SSD-16 Fuel Bowl Vent	29-02-91
		SSD-17 Valve Train	29-02-92
		SSD-18 Carburetor Cleaning	29-02-93

Light Duty and Heavy Duty Truck Engine Diagnosis and Service (Cont'd.)

**PART
29-02**

SUBJECT	PAGE	SUBJECT	PAGE
EMISSION CONTROL SYSTEM DIAGNOSIS AND SERVICE PROCEDURES (Cont'd.)		SSD-22 Evaporative Emission Control System	29-02-96
SSD-19 Decel Throttle Control System	29-02-94	SSD-26 Engine Idle Speeds (D-2)	29-02-97
		GENERAL INFORMATION	29-02-2
		SPECIFICATIONS	29-02-97

GENERAL INFORMATION

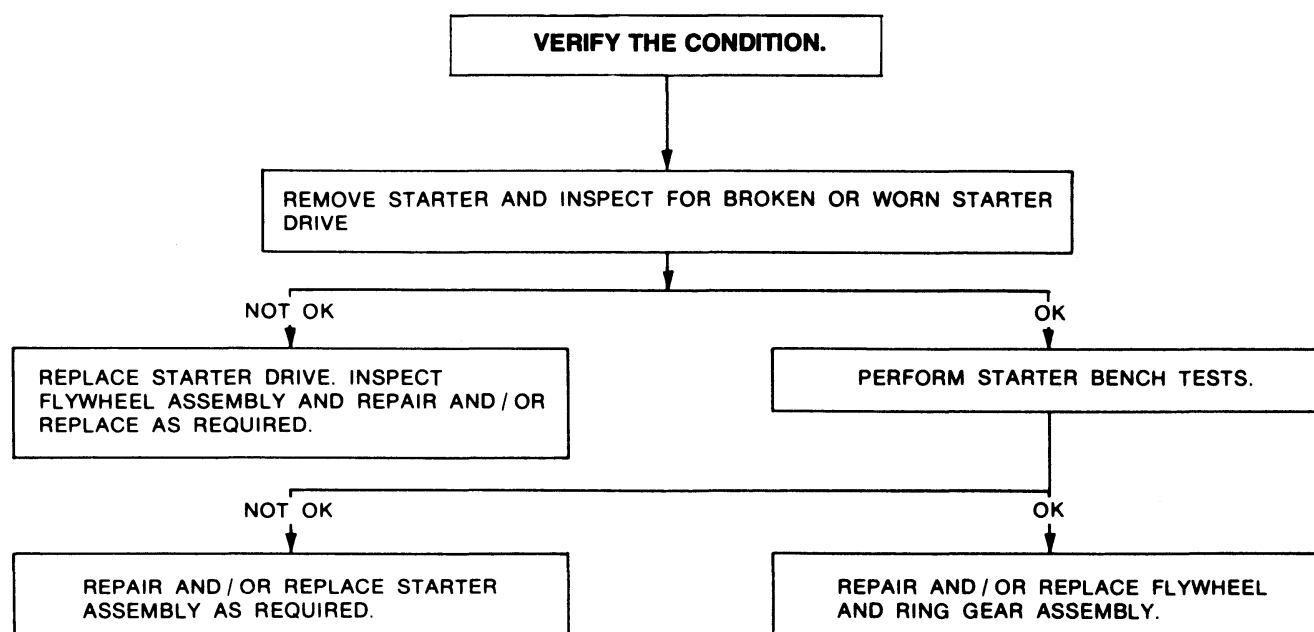
The following information comprises the Light Duty and Heavy Duty Engine Diagnosis and Service procedures related to emission system related

components. The diagnosis and related service routines provided here are the only authorized service procedures for 1980 Light Duty and Heavy Duty Trucks.

DIAGNOSIS

The following guides are provided as an aid in the diagnosis of Light Duty and Heavy Duty Engine Components.

ROUTINE NO. 101 ENGINE WILL NOT CRANK — STARTER SPINS



ROUTINE NO. 102

ENGINE WILL NOT CRANK**VERIFY THE CONDITION**

CHECK THE TRANSMISSION NEUTRAL SWITCH FOR PROPER OPERATION (IF APPLICABLE).

NOT OK

REPAIR OR ADJUST AS REQUIRED.

OK

CHECK CABLE CONNECTIONS AT BATTERY.

NOT OK

CLEAN AND TIGHTEN CONNECTIONS

OK

PERFORM BATTERY CAPACITY TEST (SHOP MANUAL).

NOT OK

CHARGE THEN RETEST BATTERY.

OK

*CONNECT VOLTMETER LEAD TO NEGATIVE POST OF BATTERY.

*CONNECT VOLTMETER LEAD TO POSITIVE POST OF BATTERY.

*TURN IGNITION KEY TO START POSITION AND LISTEN FOR CLICK. RELAY SHOULD CLICK.

NOT OK

REPLACE BATTERY.

OK

CONNECT A 12-VOLT TEST LIGHT IN SERIES WITH BATTERY POSITIVE POST AND BATTERY CABLE. LIGHT SHOULD NOT GLOW.

NOT OK

INVESTIGATE ELECTRICAL SYSTEM. REPAIR/REPLACE AS REQUIRED.

NOT OK

CONT'D. ON NEXT PAGE

OK

OBSERVE VOLTAGE.

NOT OK

VOLTAGE REMAINS SAME — MOVE VOLTMETER POSITIVE LEAD TO STARTER TERMINAL OF RELAY.

NOT OK

REPLACE RELAY.

VOLTAGE REMAINS SAME — MOVE VOLTMETER POSITIVE LEAD TO TERMINAL STUD ON STARTER.

NOT OK

REMOVE NUT AND WASHER FROM TERMINAL STUD CLEAN OR REPLACE AS REQUIRED.

VOLTAGE REMAINS SAME — REMOVE AND REPAIR STARTER.

NOT OK

REPLACE OR REPAIR AS REQUIRED.

NOT OK

REPLACE OR REPAIR AS REQUIRED.

OK

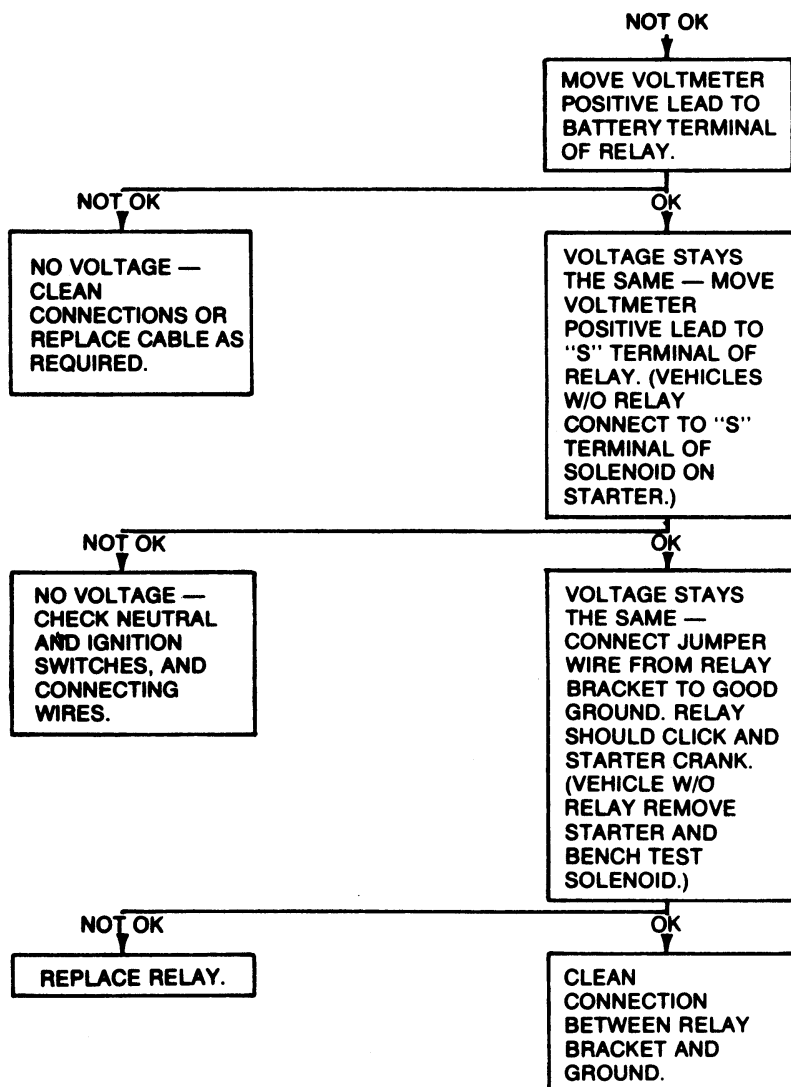
LESS THAN 10 VOLTS — EXAMINE CABLE FROM RELAY TO STARTER FOR CHAFING OR ABRASION RESULTING IN SHORT TO GROUND.

REMOVE STARTER AND PERFORM BENCH TESTS.

OK

PERFORM TESTS FOR ENGINE SEIZING AND/OR LOCK-UP.

ROUTINE NO. 102

ENGINE WILL NOT CRANK — CONTINUED

CA4345-2B2

ROUTINE NO. 103

ENGINE CRANKS SLOWLY

VERIFY THE CONDITION

PERFORM BATTERY CAPACITY TEST

NOT OK

RECHARGE AND RETEST BATTERY.

NOT OK

REPLACE BATTERY.

OK

CONNECT A 12-VOLT TEST LIGHT
IN SERIES WITH BATTERY
POSITIVE POST AND BATTERY
CABLE. LIGHT SHOULD NOT GLOW.

NOT OK

INVESTIGATE ELECTRICAL SYSTEM.
REPAIR OR REPLACE AS NECESSARY.

OK

CONNECT VOLTMETER NEGATIVE LEAD
TO STARTER TERMINAL STUD AND
VOLTMETER POSITIVE LEAD TO THE
BATTERY POSITIVE POST. INSURE THAT
THE CHOKE PLATE IS FULLY OPENED
(VERTICAL POSITION) AND DISCONNECT
COIL PRIMARY WIRE (BATTERY SIDE).
CRANK THE ENGINE AND OBSERVE
VOLTMETER READING. IT SHOULD NOT
EXCEED 0.5 VOLTS.

OK

NOT OK

DISCONNECT AND CLEAN CONNECTION AT
POSITIVE BATTERY POST, RELAY AND AT
STARTER TERMINAL.

OK

CONNECT VOLTMETER NEGATIVE LEAD TO
NEGATIVE BATTERY POST, AND VOLTMETER
POSITIVE LEAD TO STARTER MOUNTING BOLT
OR ENGINE GROUND. INSURE THAT THE CHOKE
PLATE IS FULLY OPENED (VERTICAL POSITION)
AND DISCONNECT COIL PRIMARY WIRE (BATTERY
SIDE). CRANK THE ENGINE AND OBSERVE
VOLTMETER READING. IT SHOULD NOT EXCEED
0.1 VOLTS.

NOT OK

DISCONNECT AND CLEAN CONNECTIONS AT
NEGATIVE BATTERY POST AND GROUND CABLE
CONNECTIONS AT ENGINE BLOCK.

OK

REMOVE STARTER AND PERFORM BENCH TESTS.

NOT OK

REPAIR AND/OR REPLACE AS REQUIRED.

OK

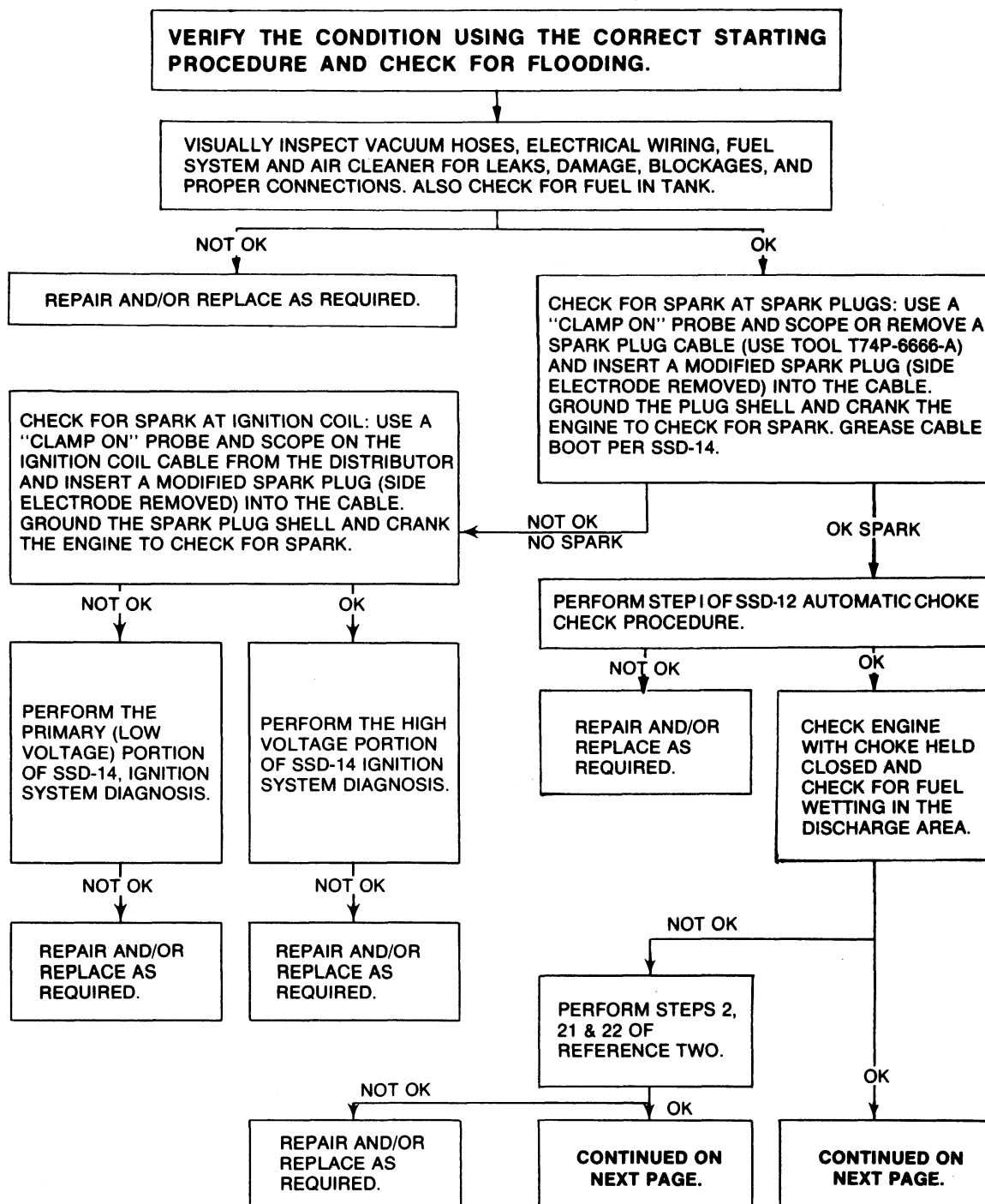
PERFORM ENGINE CHECKS FOR SEIZING,
HIGH FRICTION, OR OVER HEATING.

NOT OK

REPAIR AND/OR REPLACE AS REQUIRED.

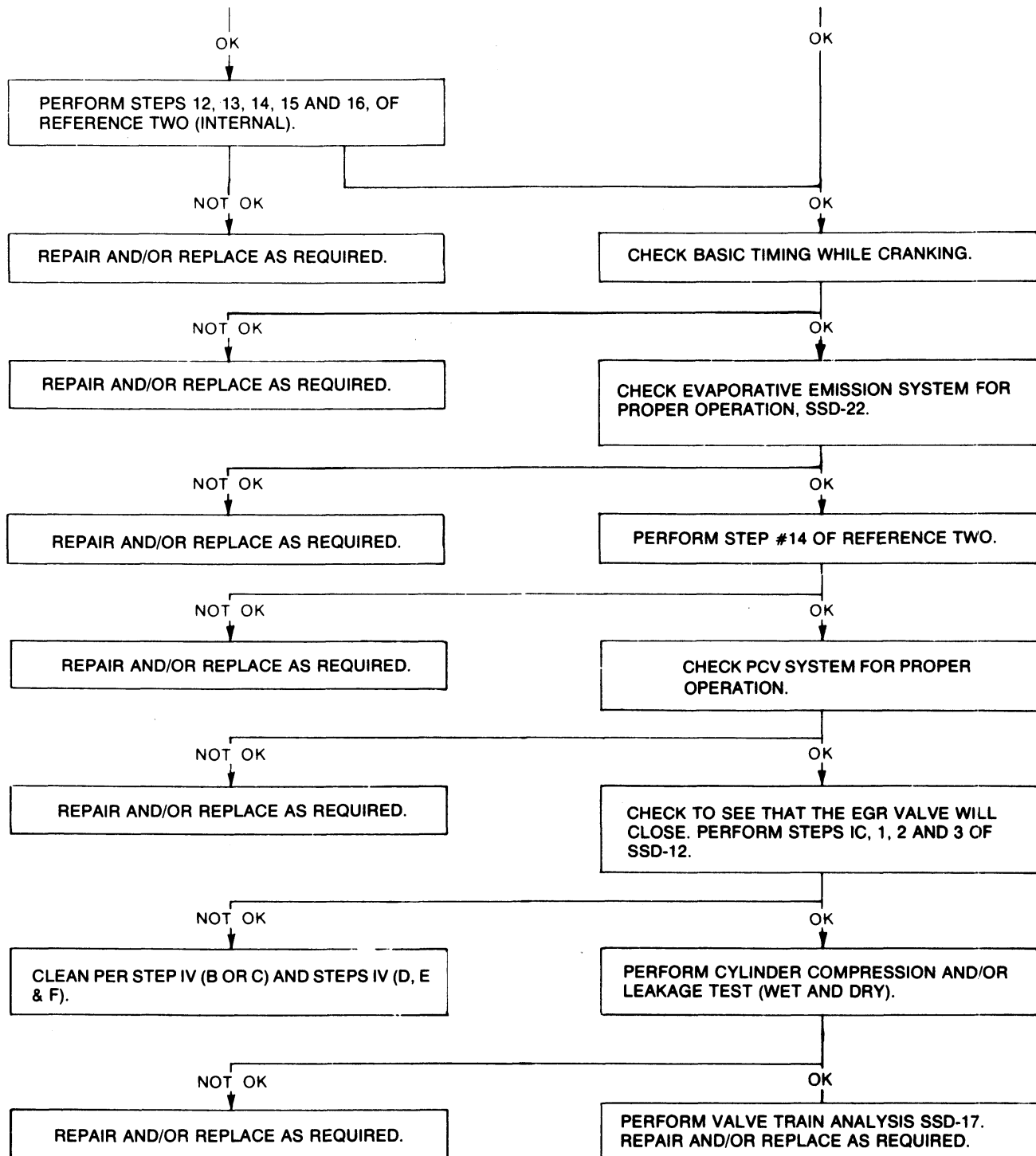
ROUTINE NO. 104

ENGINE CRANKS NORMALLY — WILL NOT START



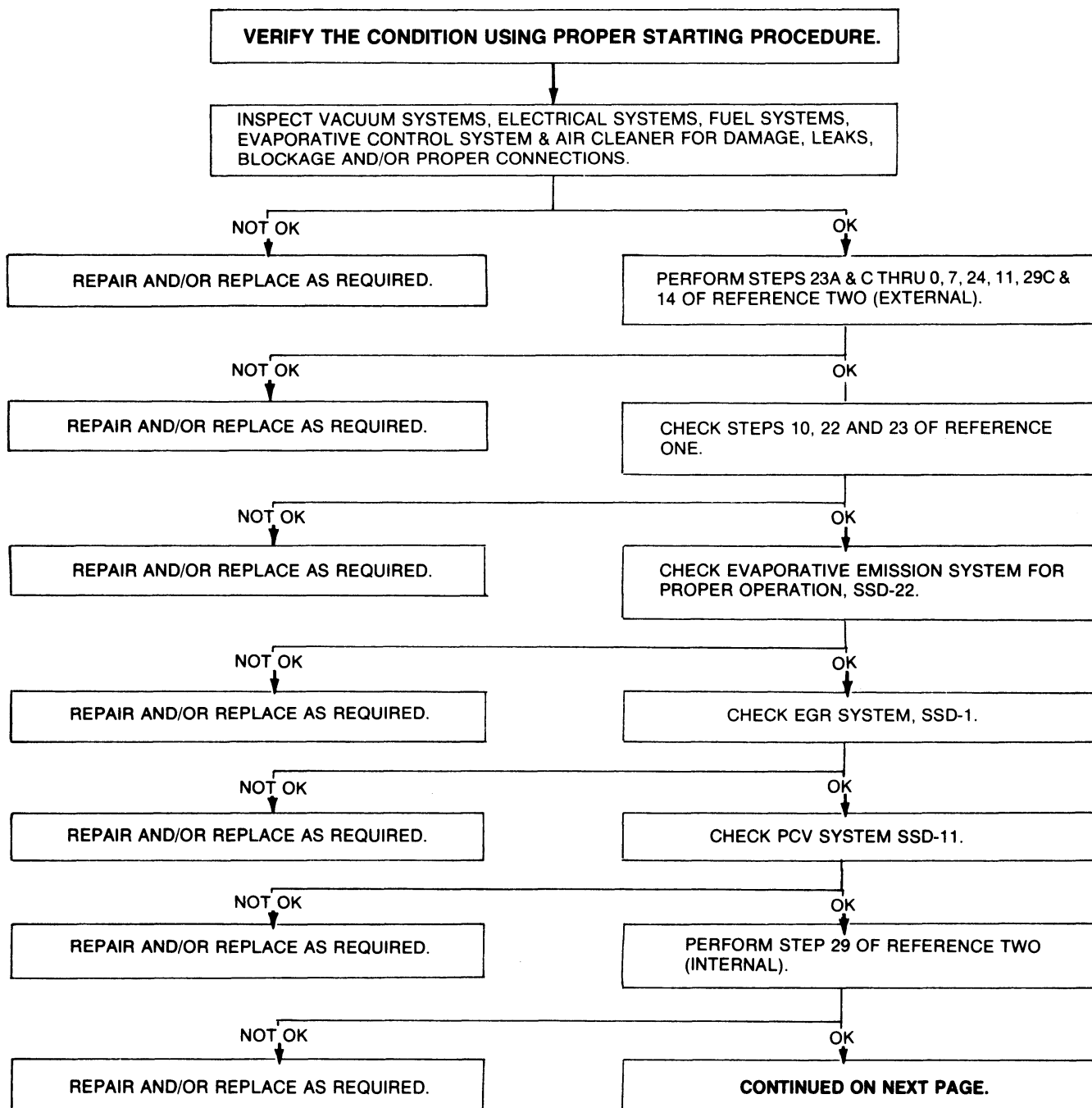
ROUTINE NO. 104

ENGINE CRANKS NORMALLY — WILL NOT START — CONTINUED

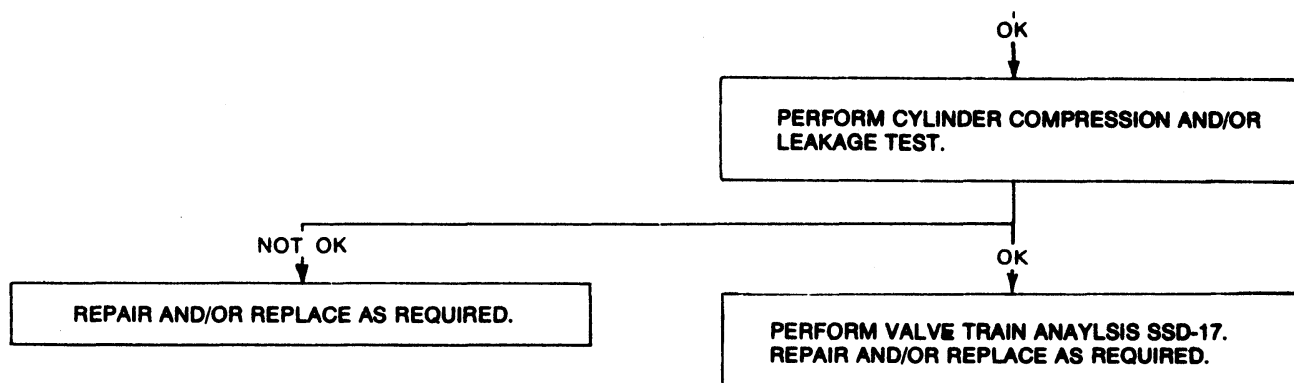


ROUTINE NO. 105

ENGINE CRANKS NORMALLY — STARTS HARD WHEN COLD



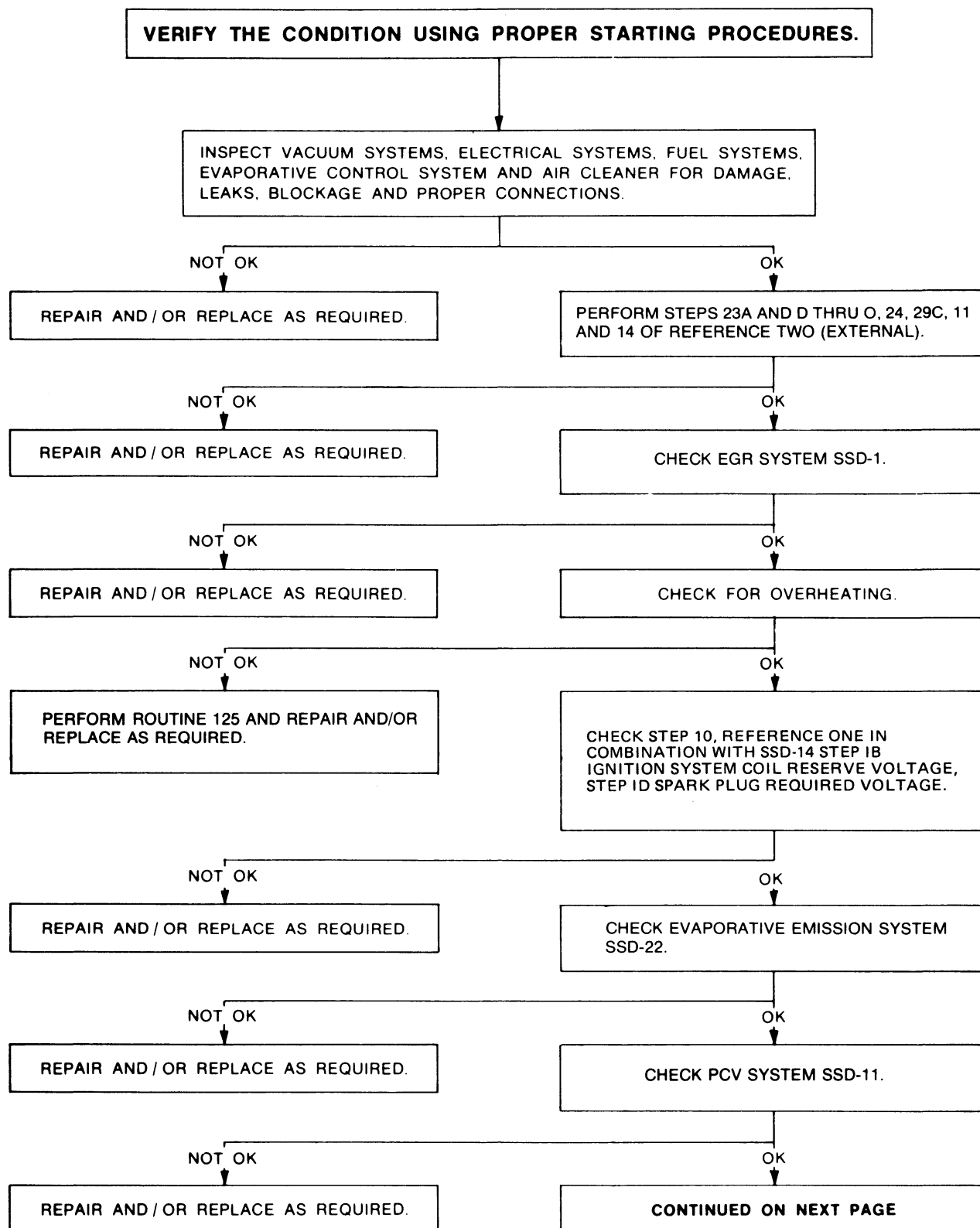
ROUTINE NO. 105
ENGINE CRANKS NORMALLY —
STARTS HARD WHEN COLD — CONTINUED



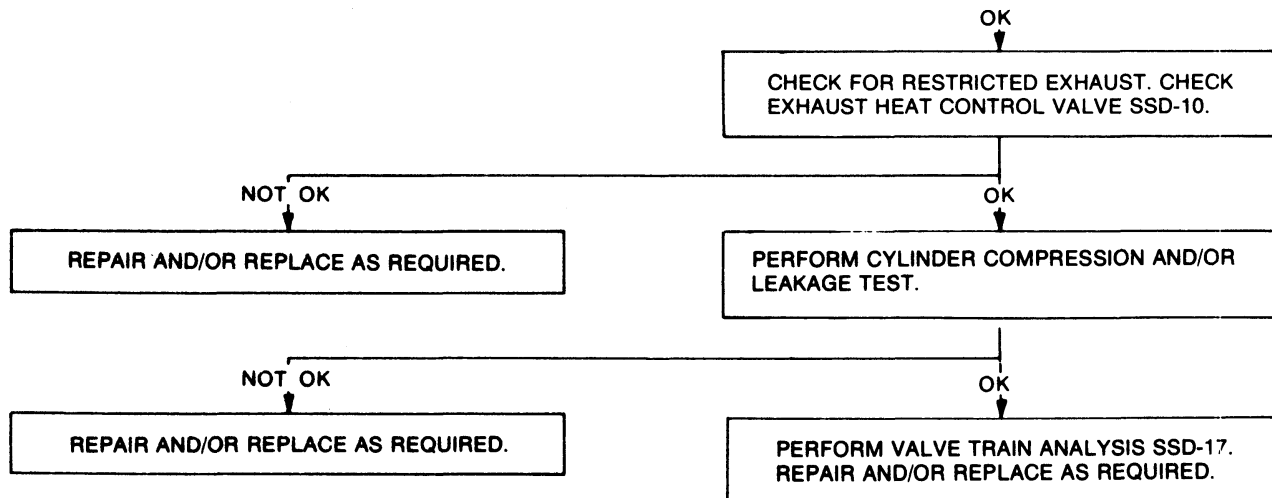
CA4348-2C2

ROUTINE NO. 106

ENGINE CRANKS NORMALLY — STARTS HARD WHEN HOT



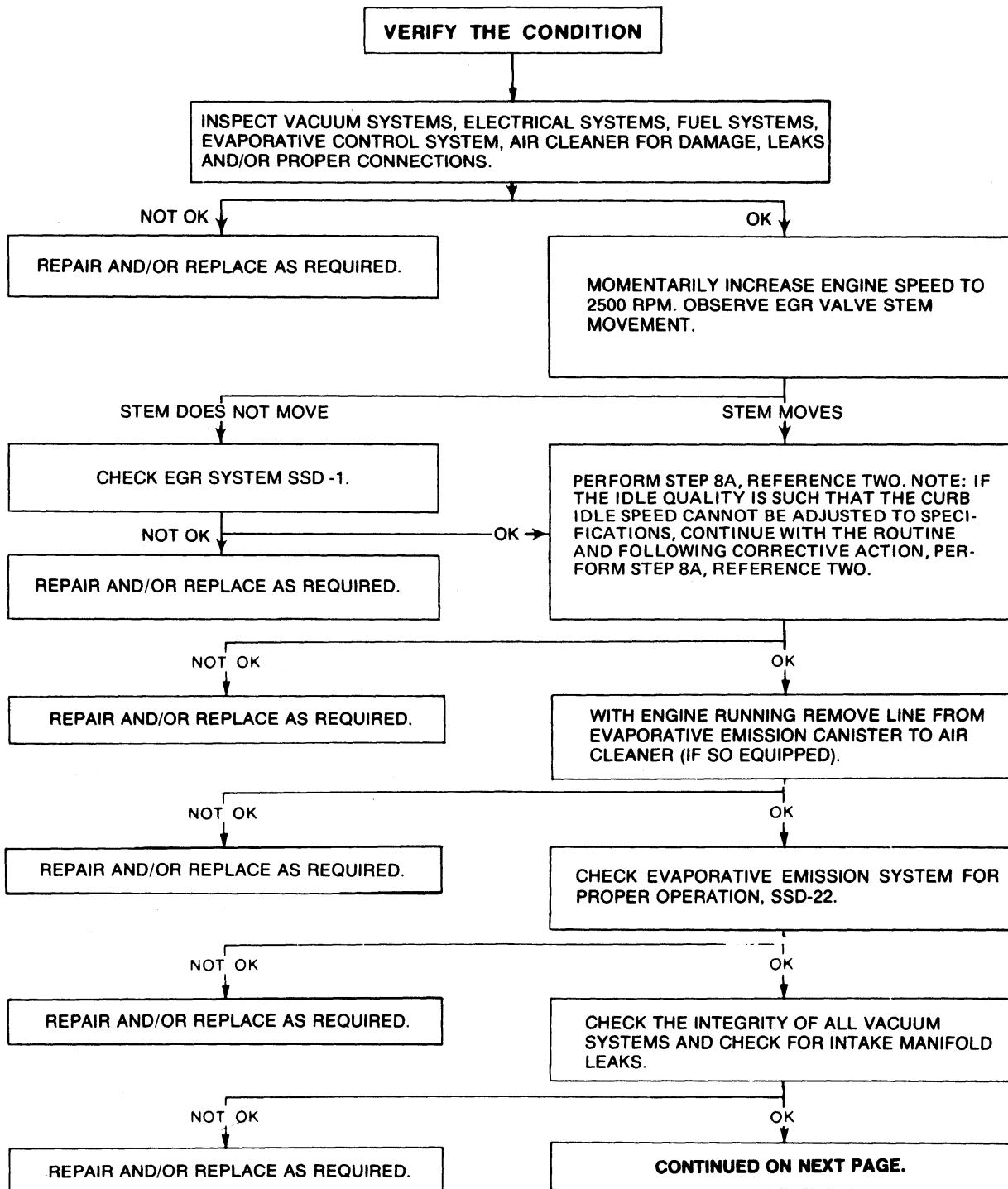
ROUTINE NO. 106
ENGINE CRANKS NORMALLY —
STARTS HARD WHEN HOT — CONTINUED



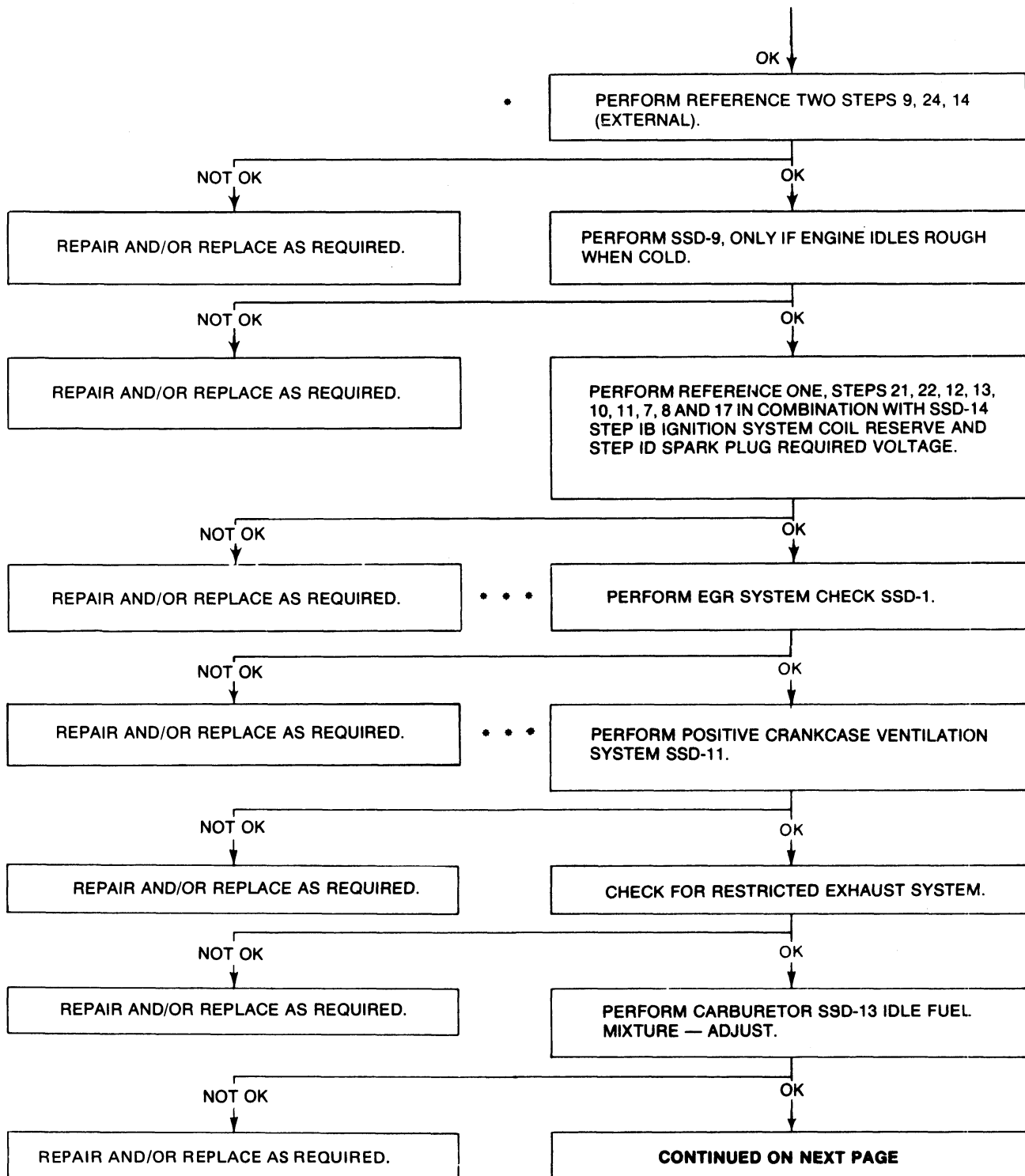
CA4349-2D2

ROUTINE NO. 107

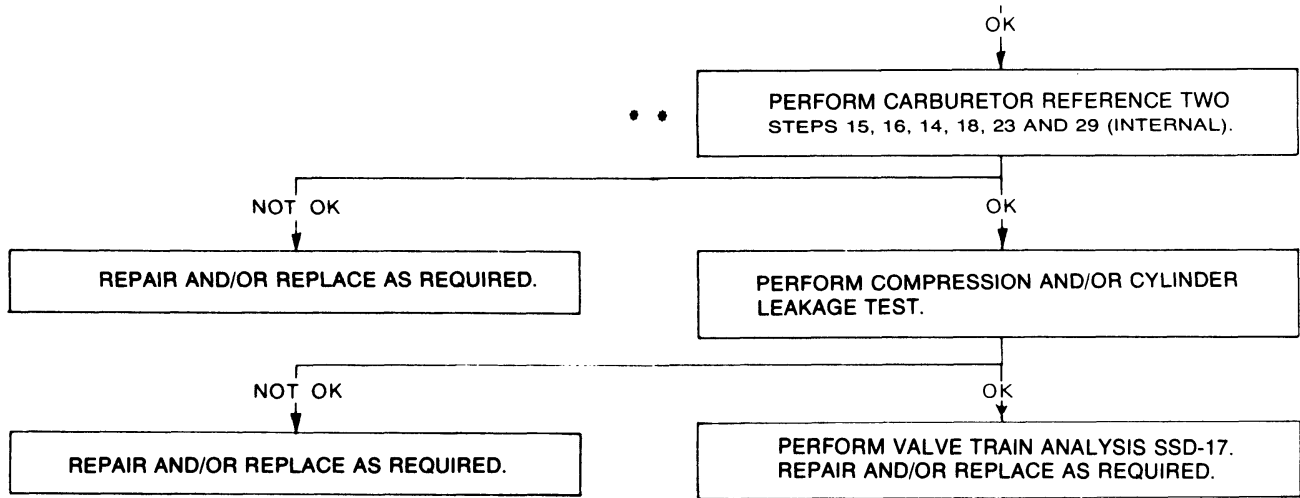
ENGINE IDLES ROUGH/MISSES WARM OR COLD ENGINE



ROUTINE NO.107
ENGINE IDLES ROUGH/MISSES
WARM OR COLD ENGINE — CONTINUED



ROUTINE NO. 107
ENGINE IDLES ROUGH/MISSES
WARM OR COLD ENGINE — CONTINUED



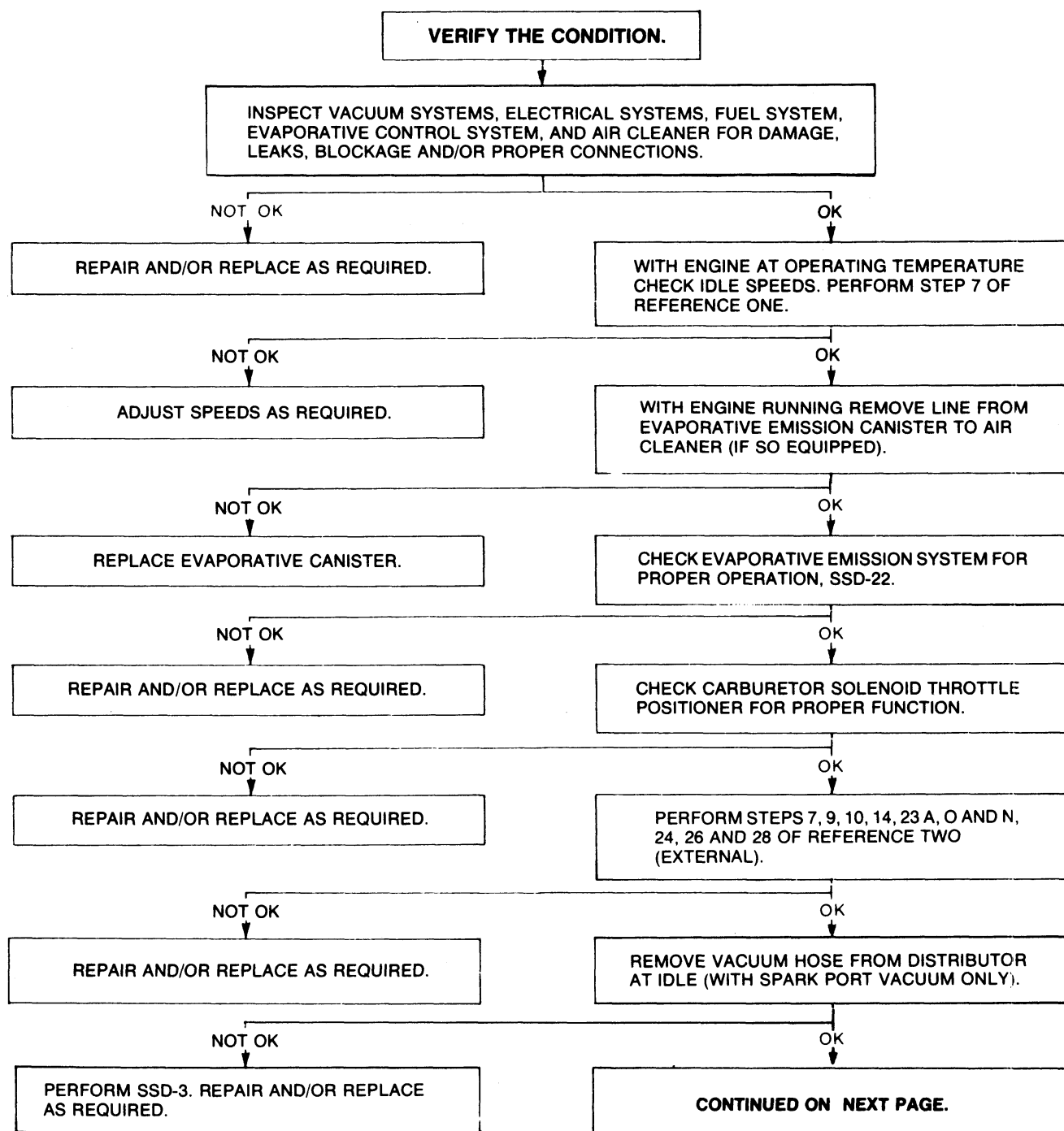
*IF ENGINE IDLES ROUGH/MISSES ONLY WHEN COLD, PERFORM STEP 23, REFERENCE TWO, BEFORE PERFORMING STEPS 9, 11 AND 24, REFERENCE TWO.

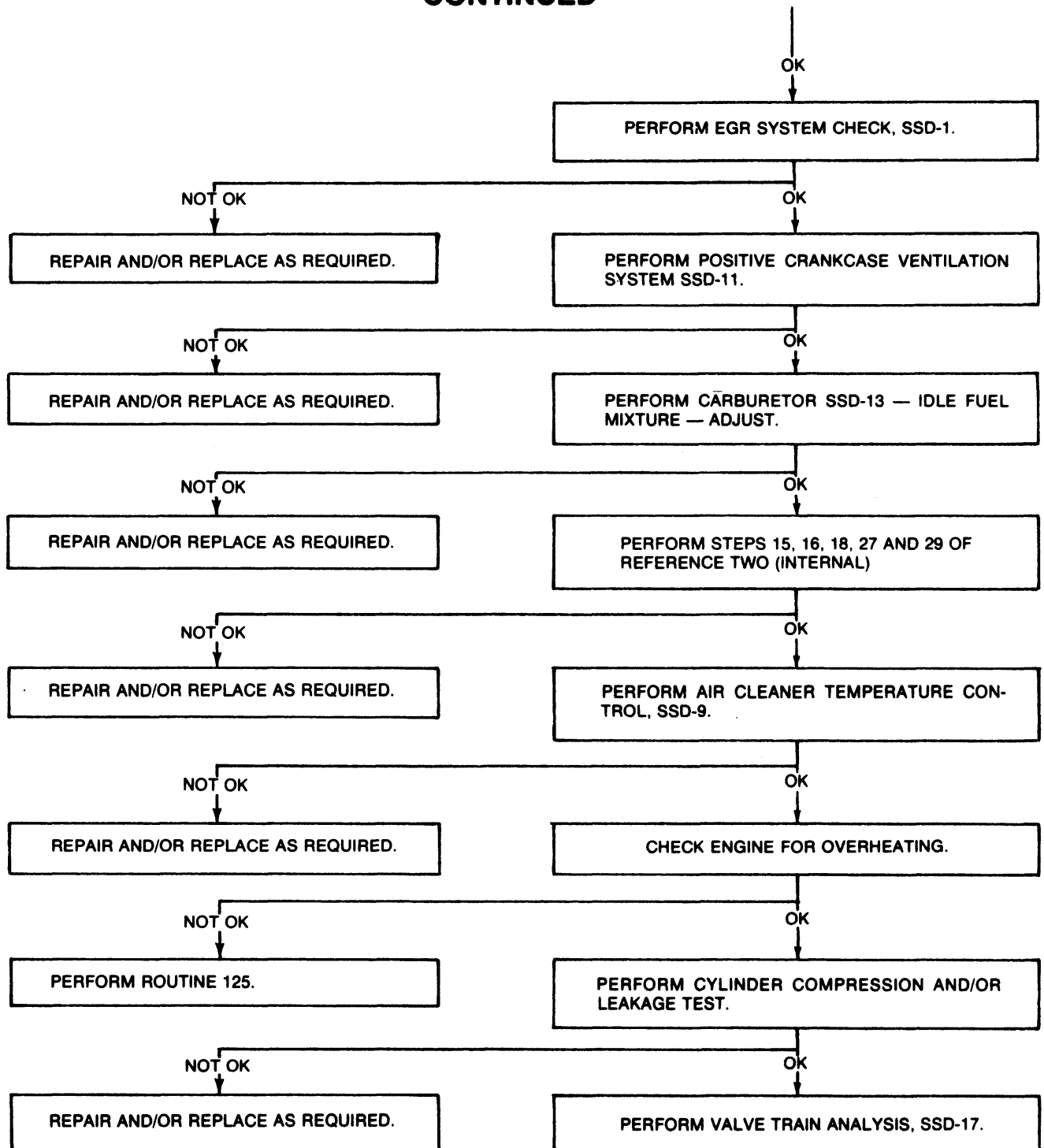
**PERFORM STEP 23, REFERENCE TWO, OF THIS STEP ONLY IF IT WAS NOT PERFORMED EARLIER IN THE ROUTINE.

***IF ENGINE IDLES ROUGH ONLY WHEN COLD PERFORM THIS STEP AFTER PERFORMING CARBURETOR REFERENCE TWO STEPS 15, 16, 18, 23 AND 29.

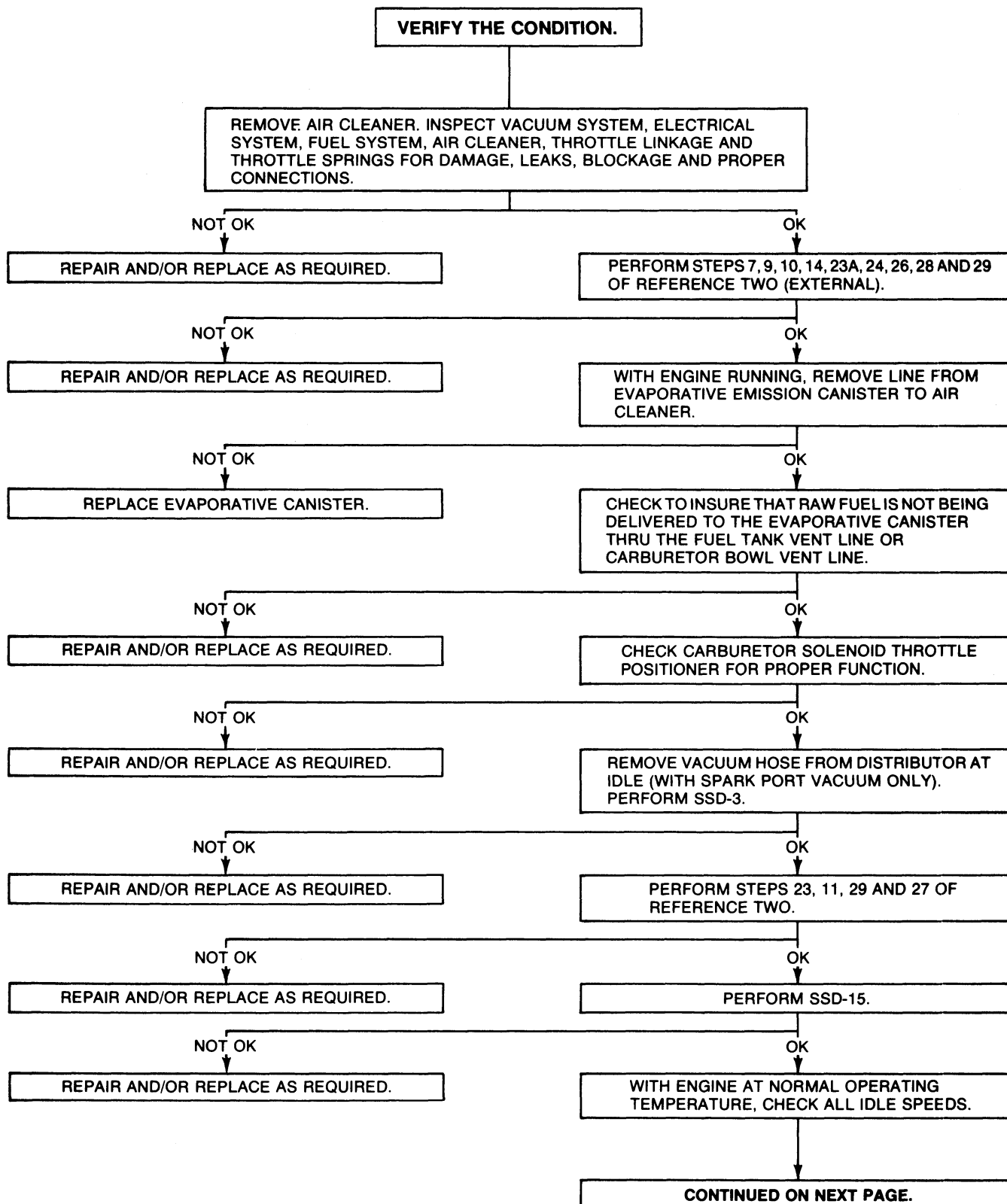
CA4350-2D3

ROUTINE NO. 108 ENGINE IDLE SPEED VARIES

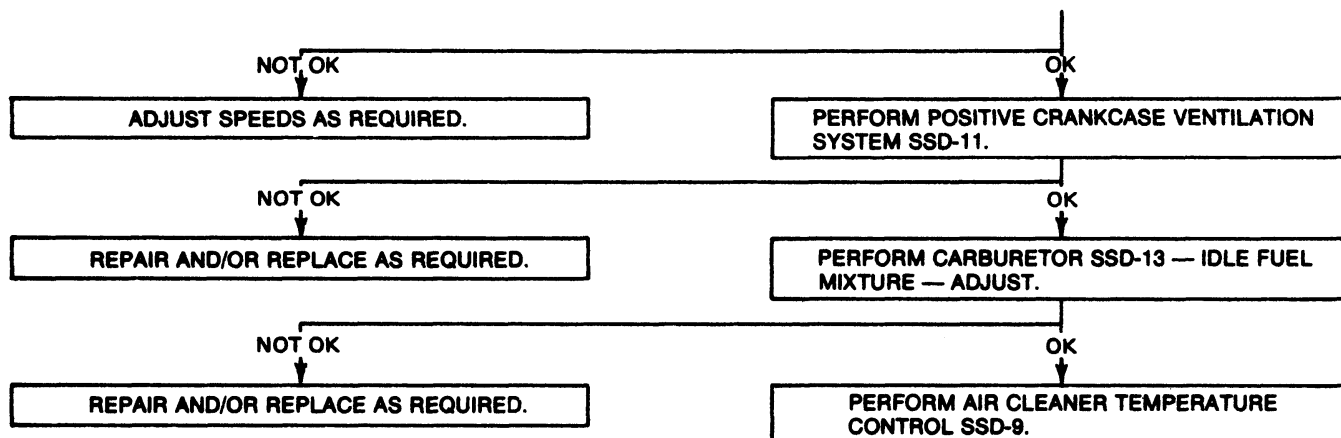


ROUTINE NO. 108**ENGINE IDLE SPEED VARIES —
CONTINUED**

ROUTINE NO. 108A ENGINE IDLE SPEED IS HIGH

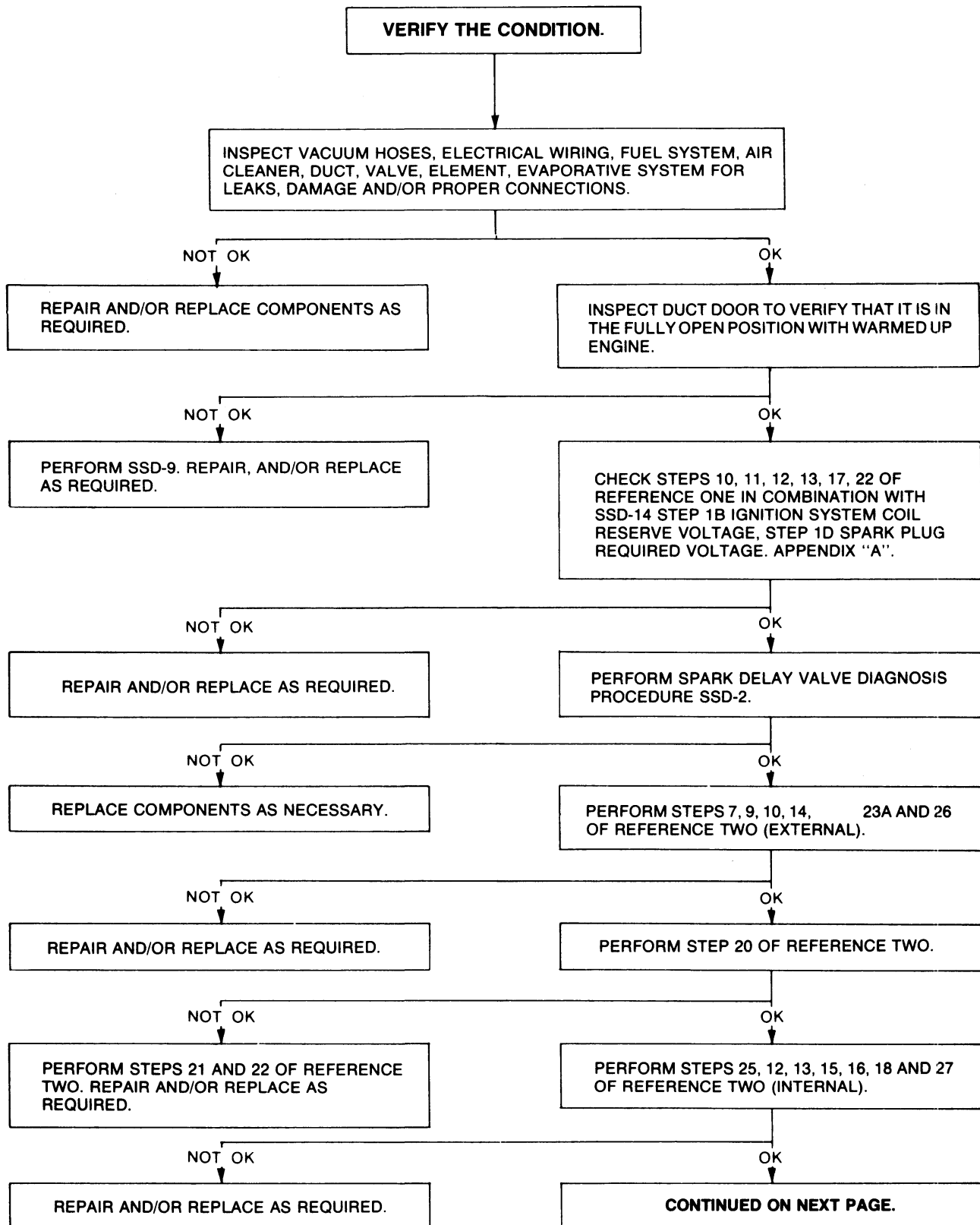


ROUTINE NO. 108A
ENGINE IDLE SPEED IS HIGH (CONTINUED)

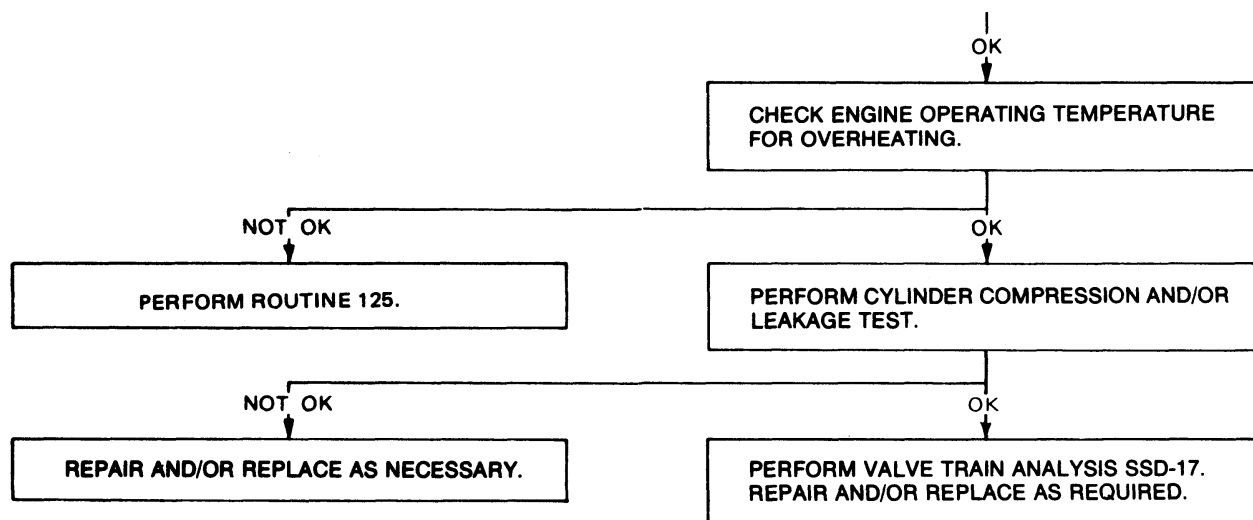


CA4798-2A

ROUTINE NO. 109 ENGINE MISSES AT HIGH SPEED

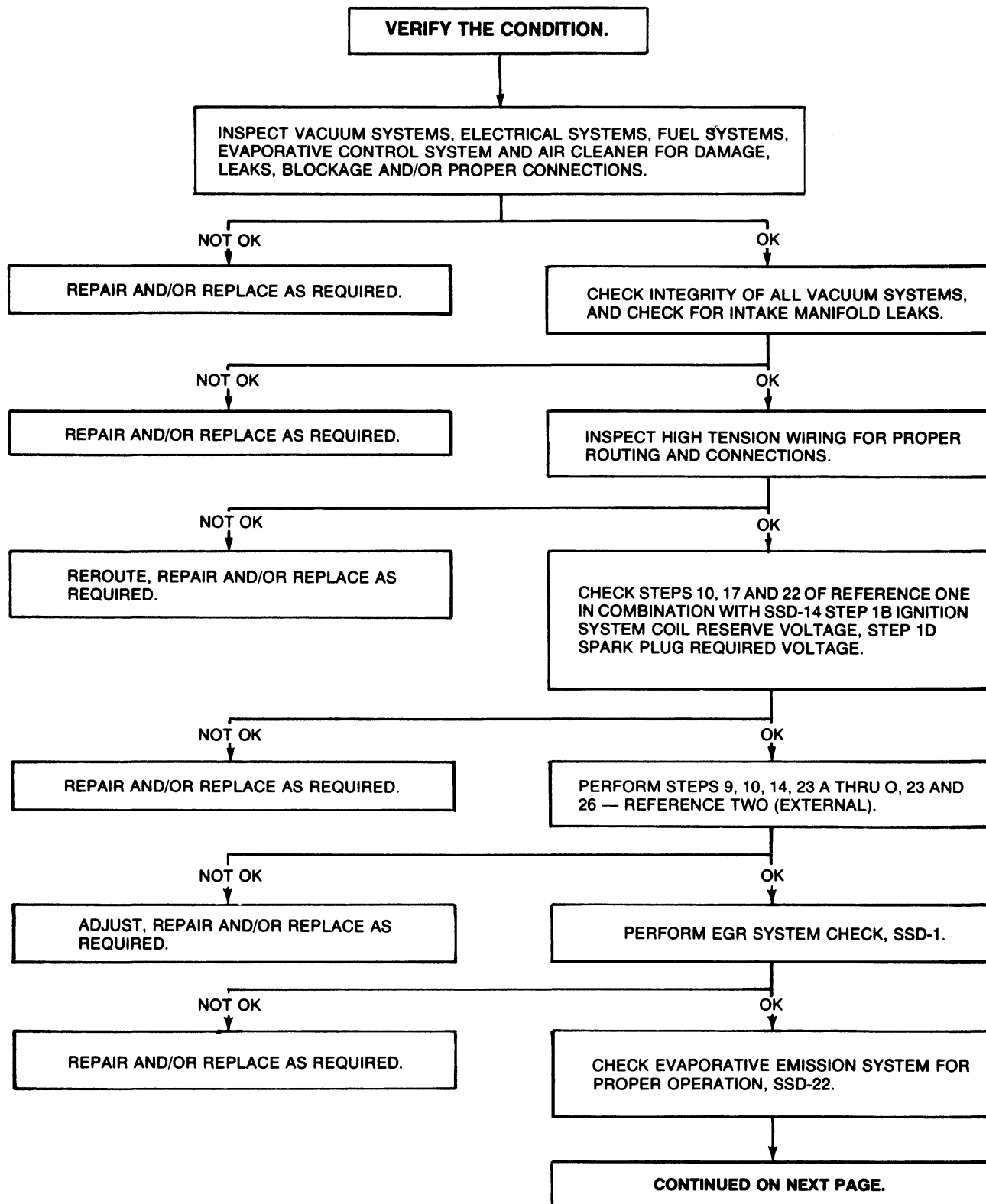


ROUTINE NO. 109 ENGINE MISSES AT HIGH SPEED — CONTINUED



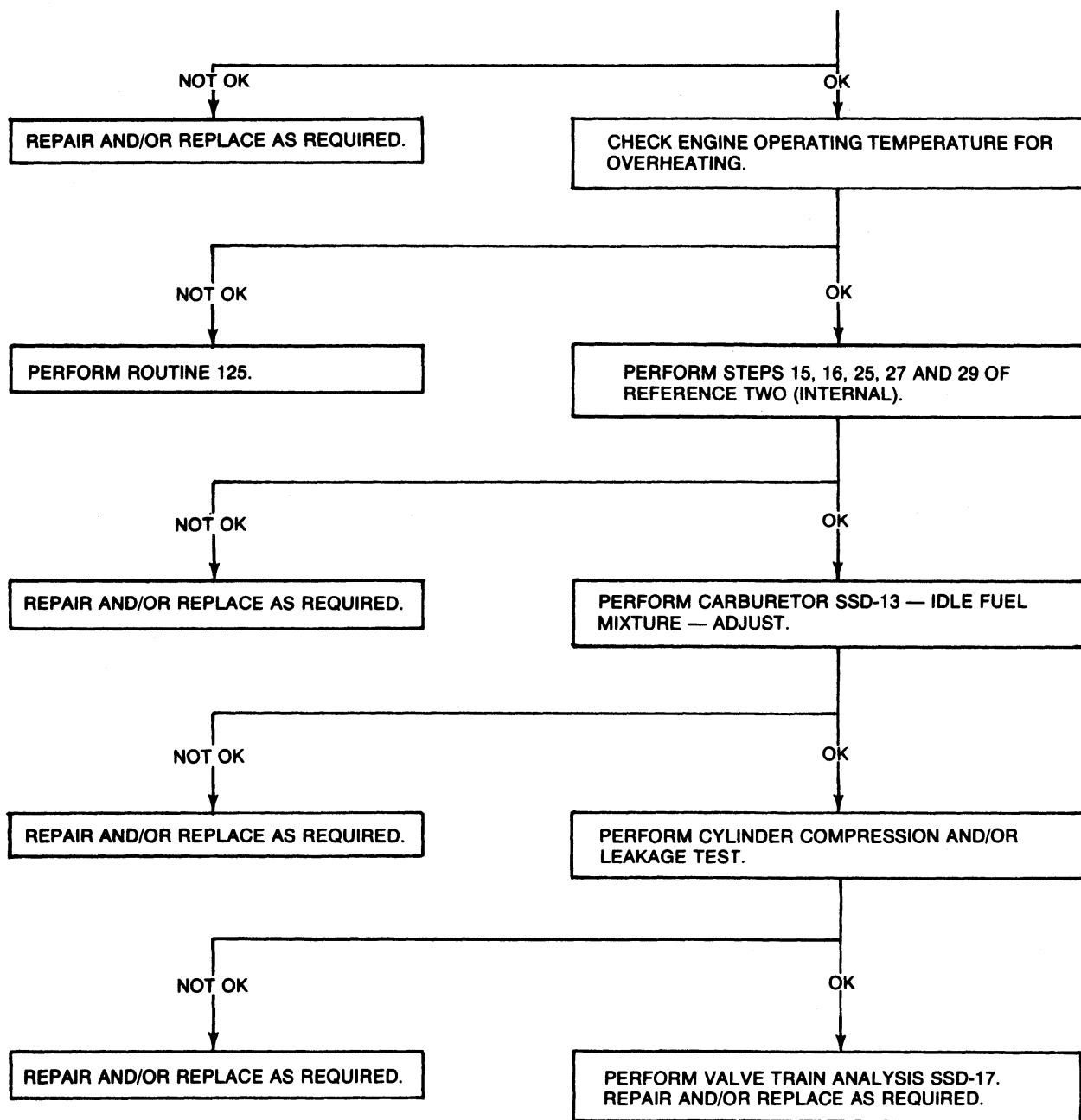
CA4352-2C2

ROUTINE NO. 110 ENGINE MISSES AT LOW SPEEDS



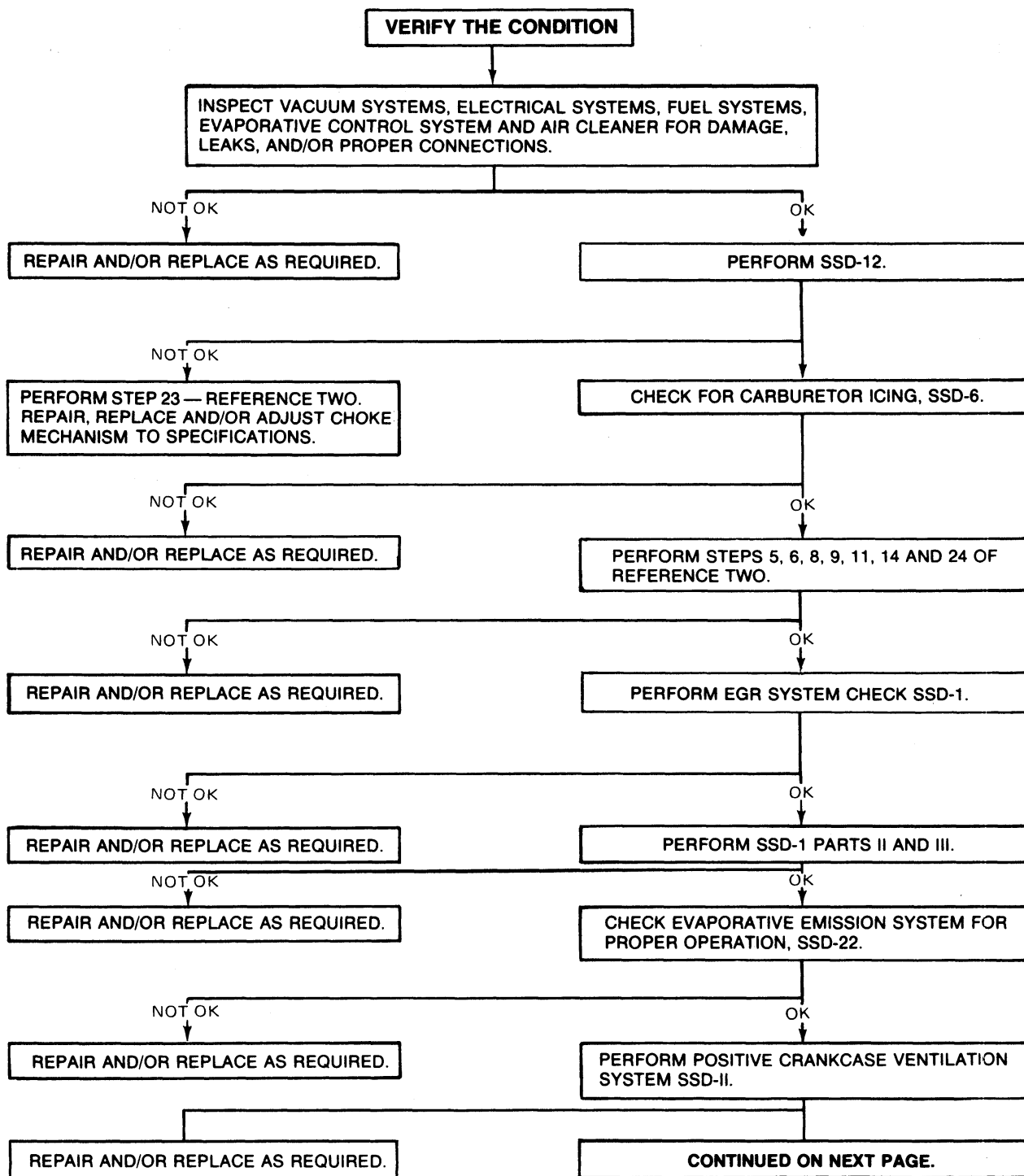
ROUTINE NO. 110

ENGINE MISSES AT LOW SPEEDS — CONTINUED



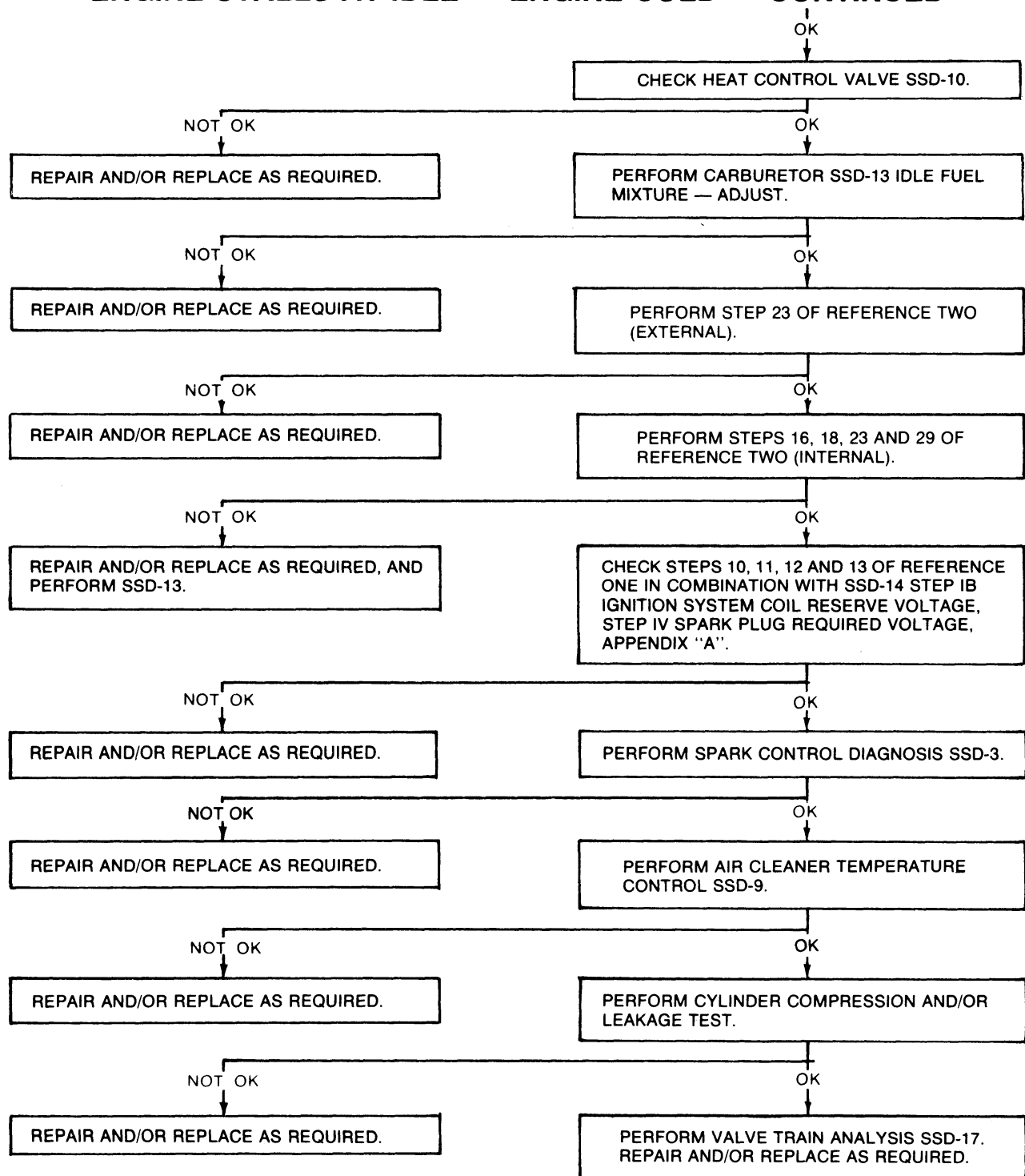
ROUTINE NO. 111

ENGINE STALLS AT IDLE — ENGINE COLD

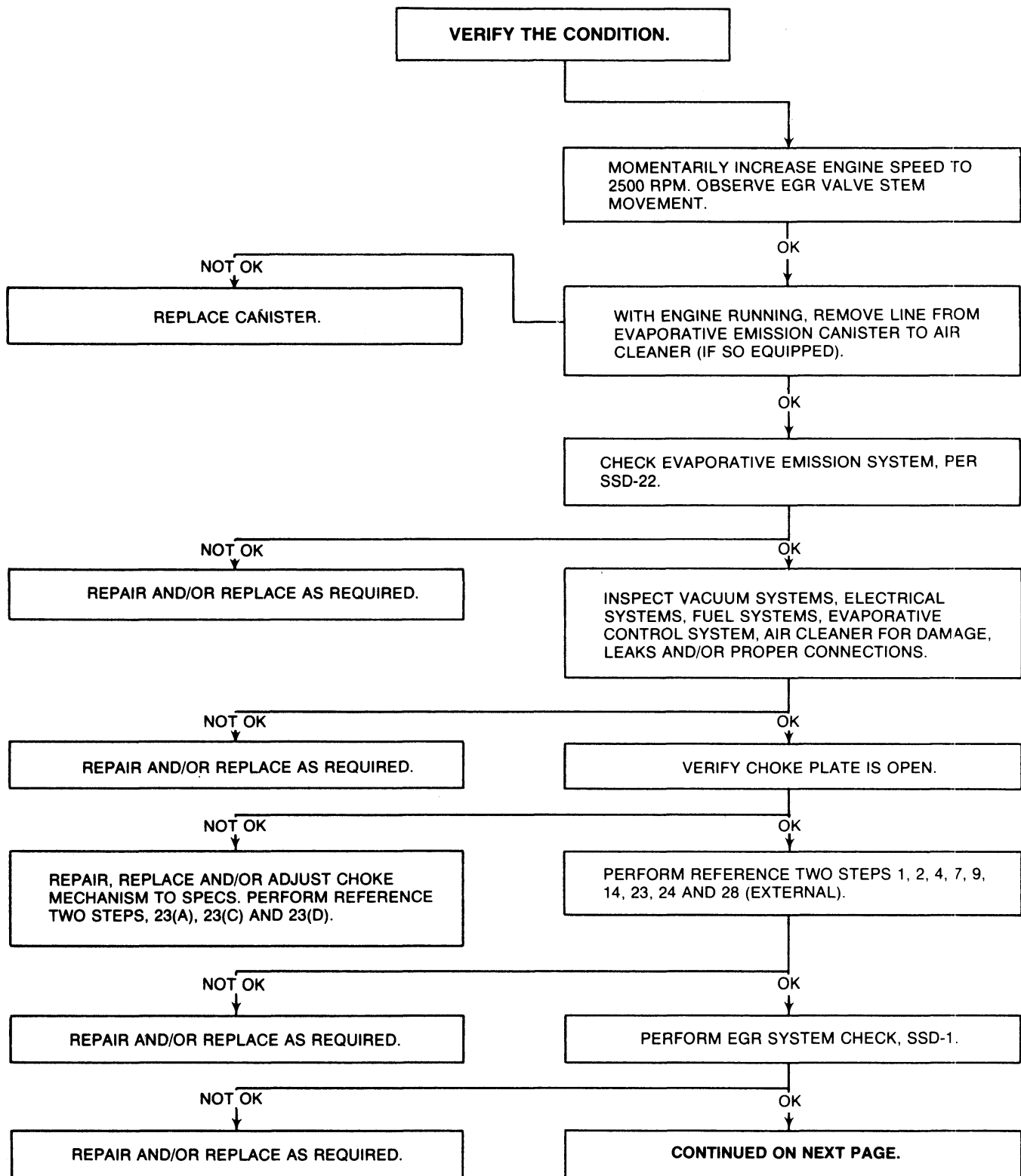


ROUTINE NO. 111

ENGINE STALLS AT IDLE — ENGINE COLD — CONTINUED

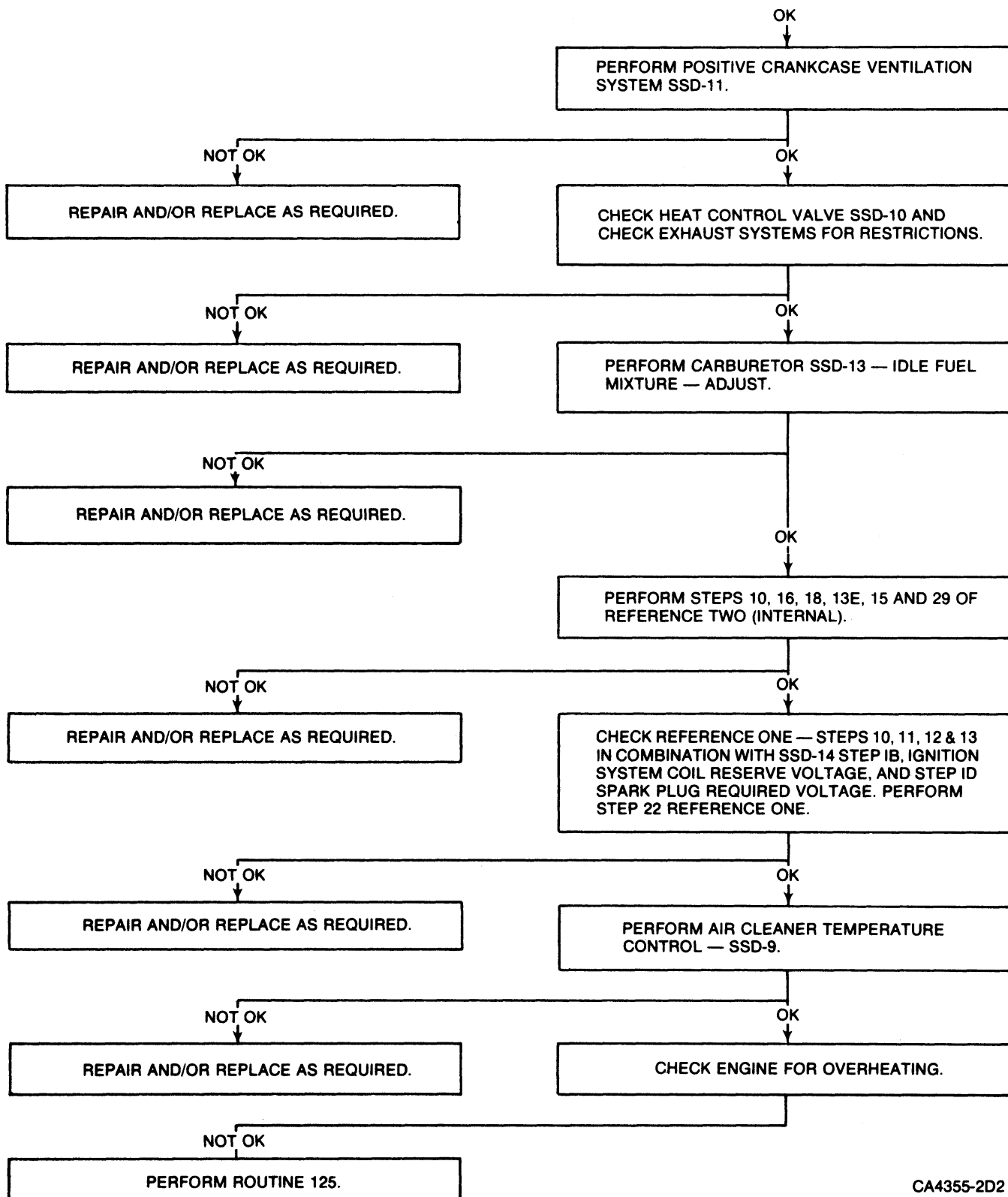


ROUTINE NO. 112 ENGINE STALLS AT IDLE — ENGINE HOT



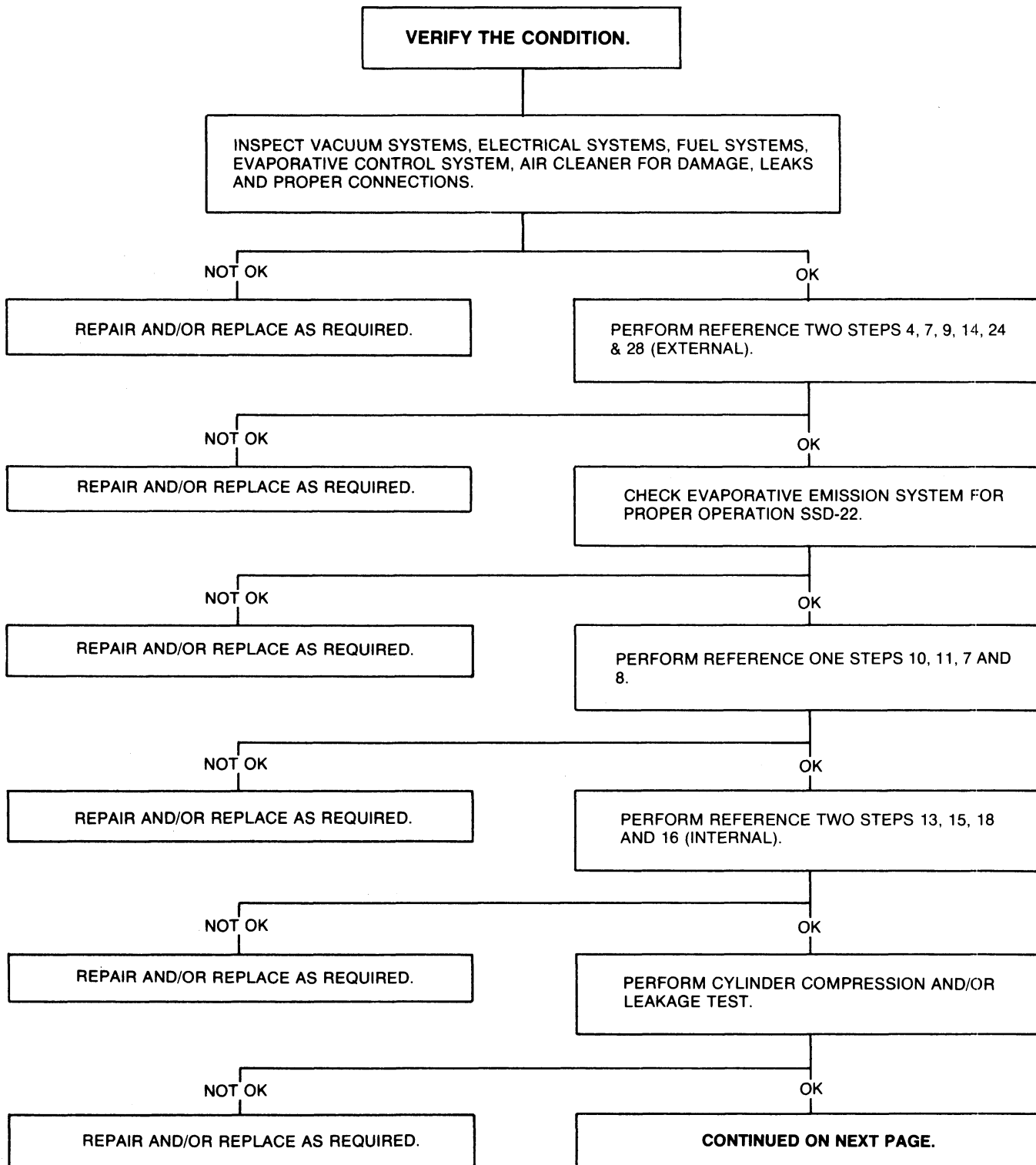
ROUTINE NO. 112

ENGINE STALLS AT IDLE — ENGINE HOT — CONTINUED

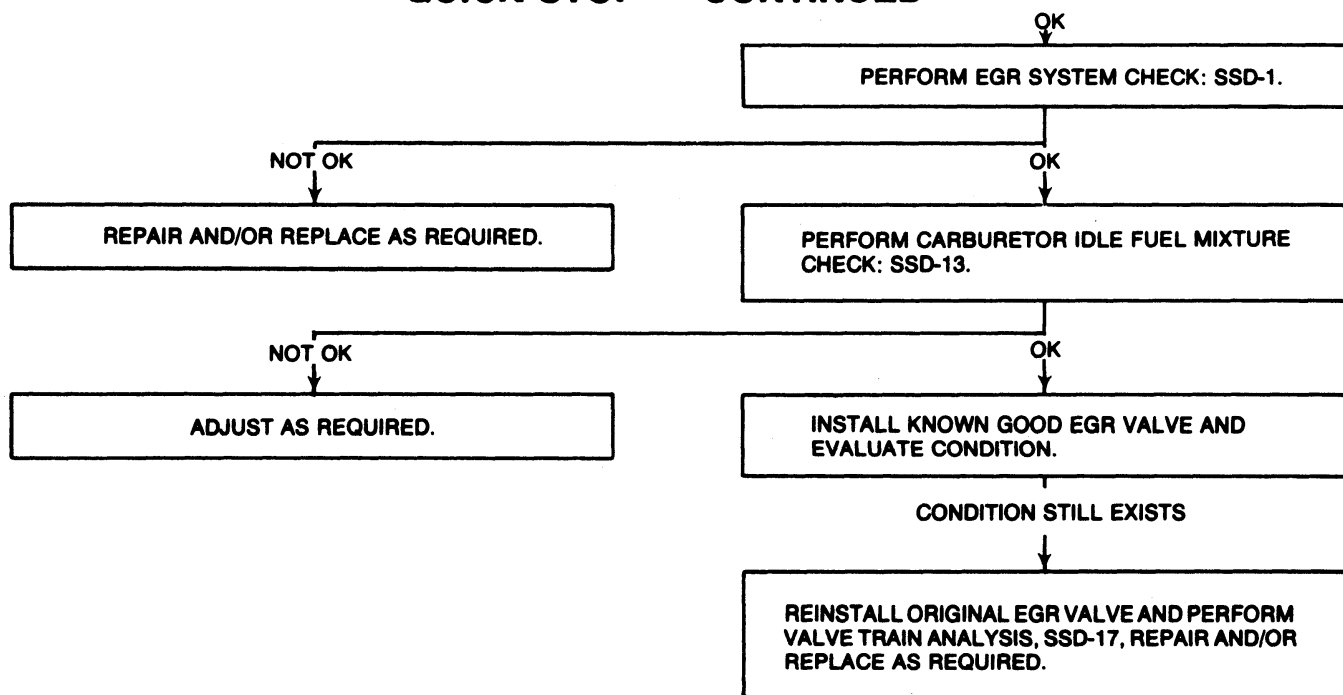


ROUTINE NO. 113

ENGINE STALLS DURING DECELERATION OR ON QUICK STOP



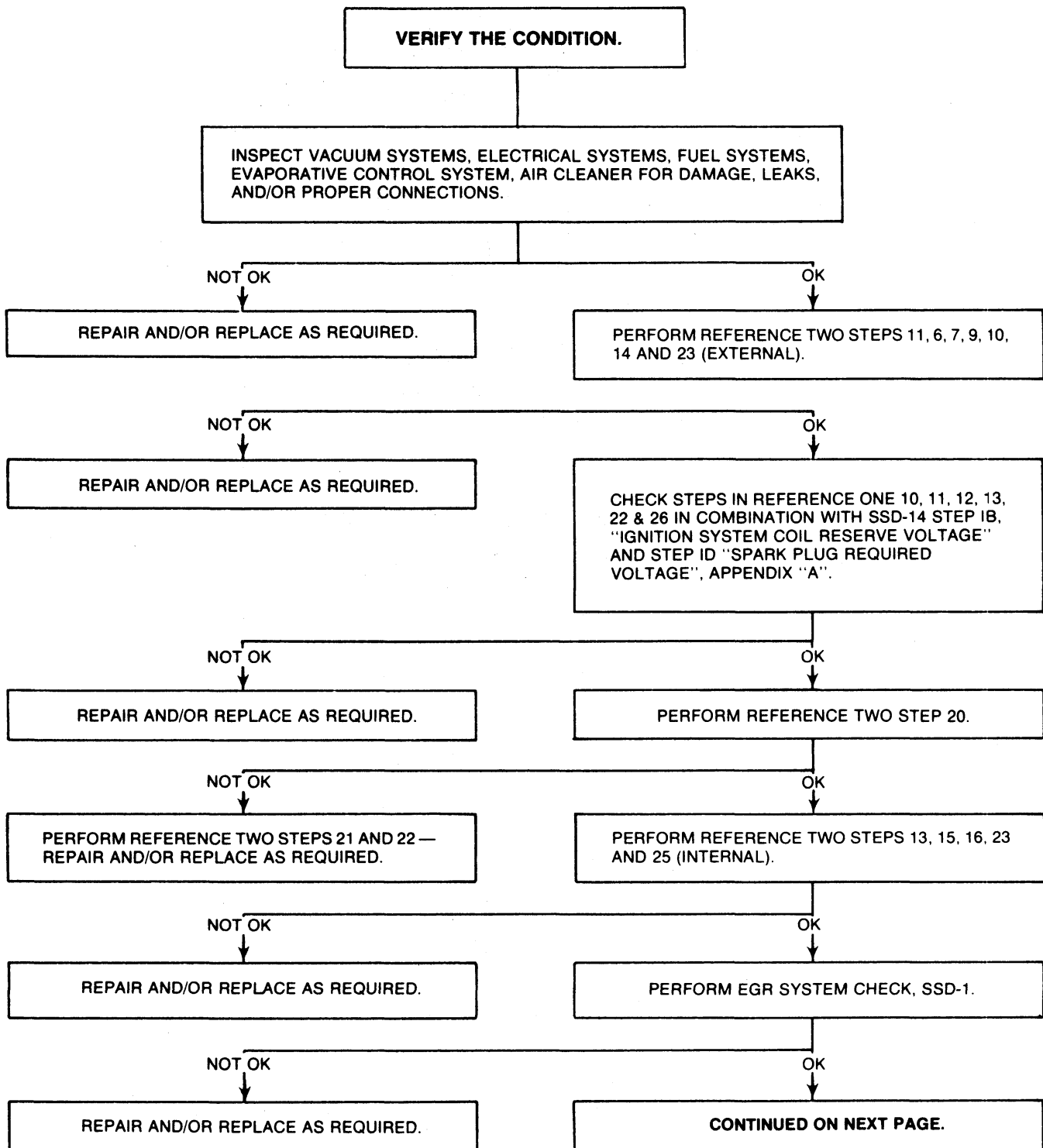
ROUTINE NO. 113
ENGINE STALLS DURING DECELERATION OR ON
QUICK STOP — CONTINUED



CA4356-2C2

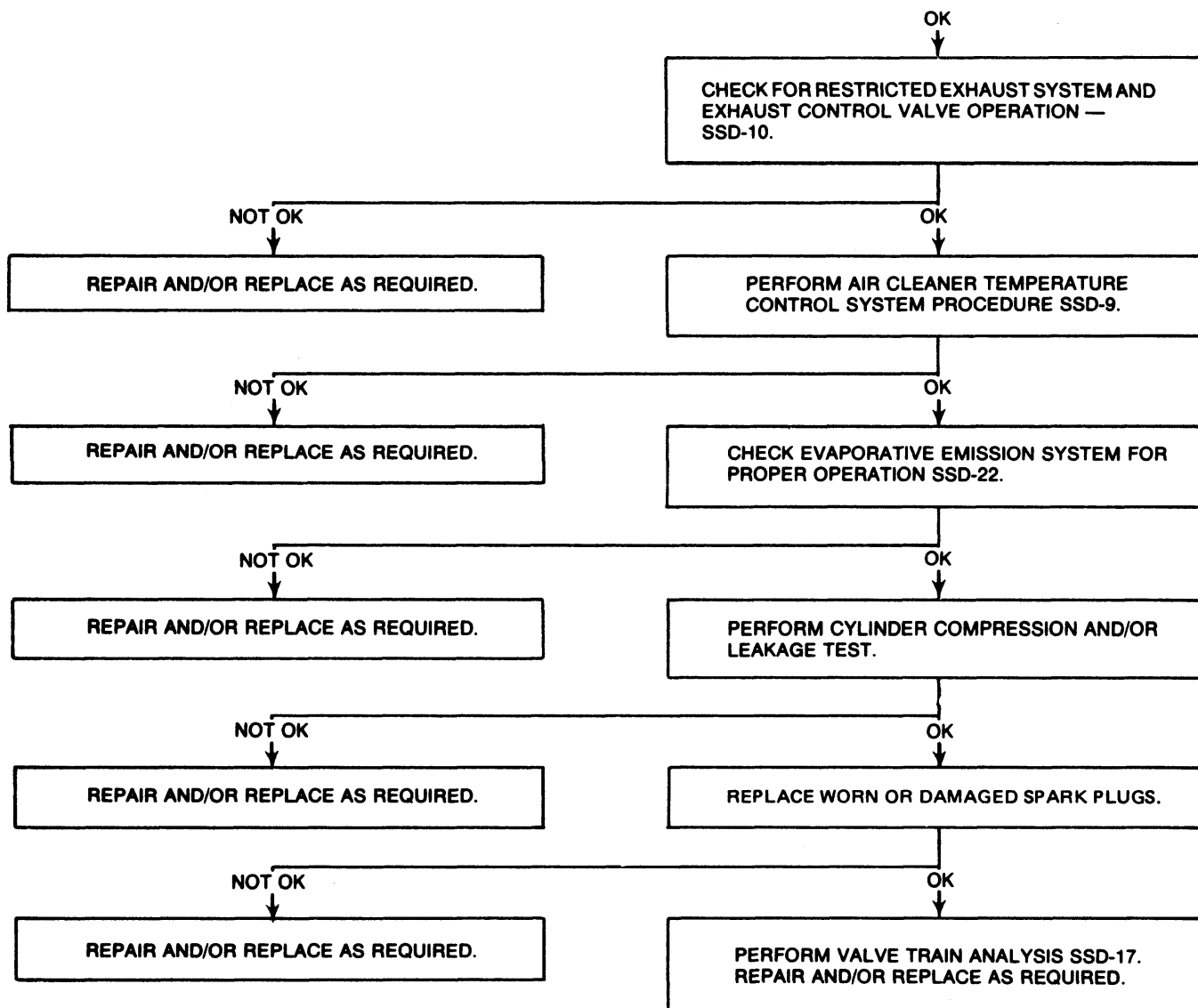
ROUTINE NO. 114

ENGINE HESITATES/STALLS DURING ACCELERATION



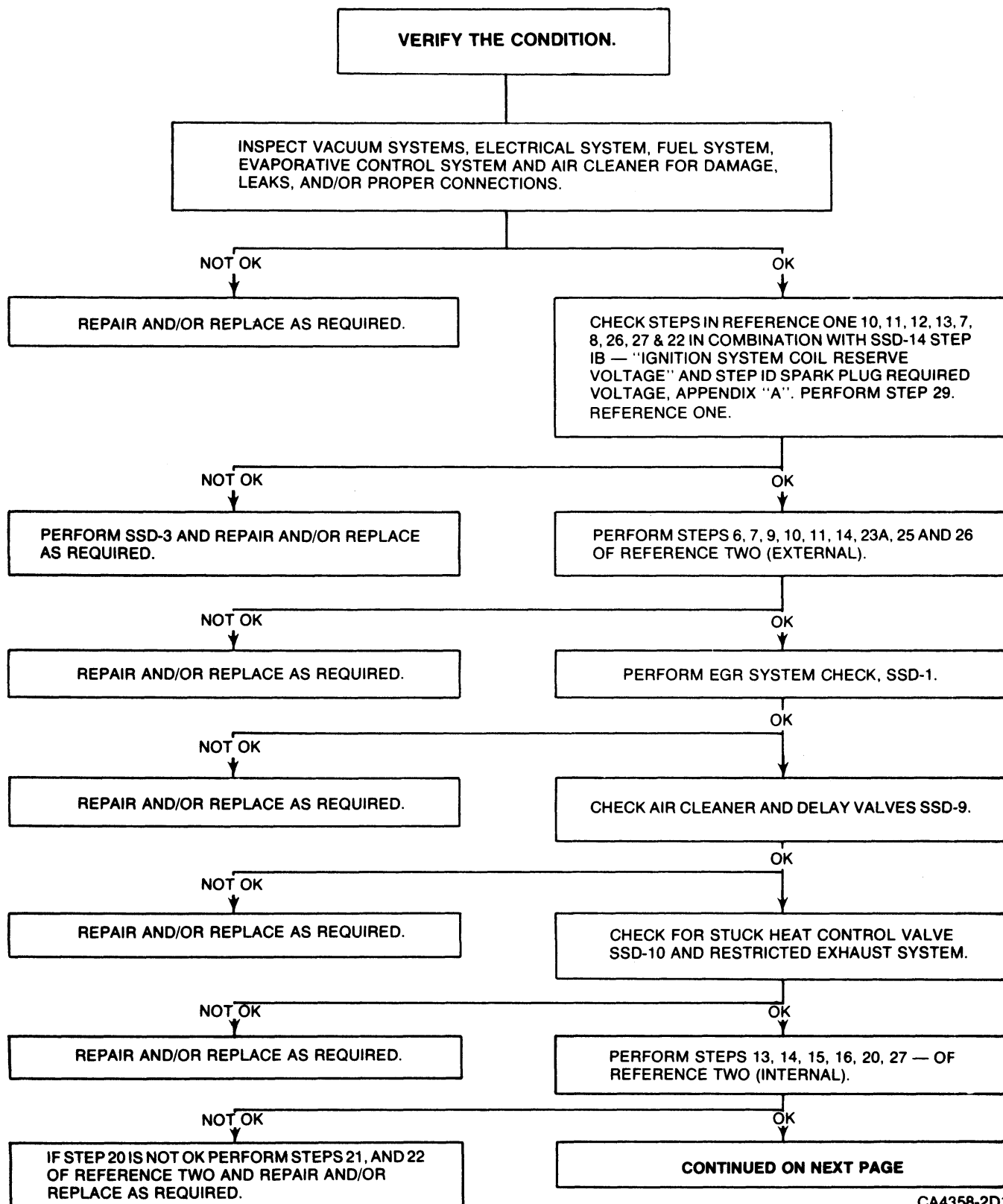
ROUTINE NO. 114

ENGINE HESITATES/STALLS DURING ACCELERATION — CONTINUED

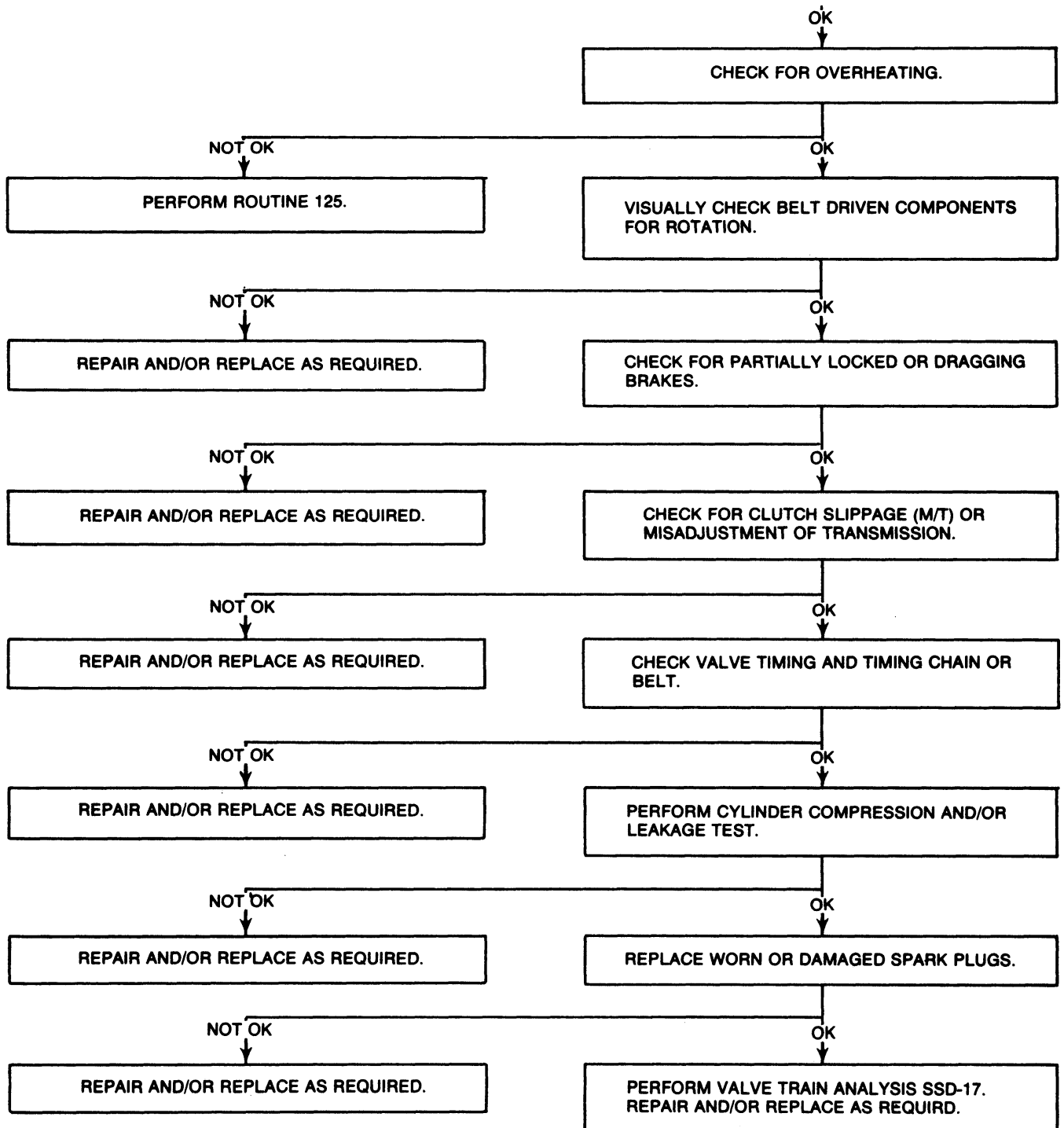


CA4357-2C2

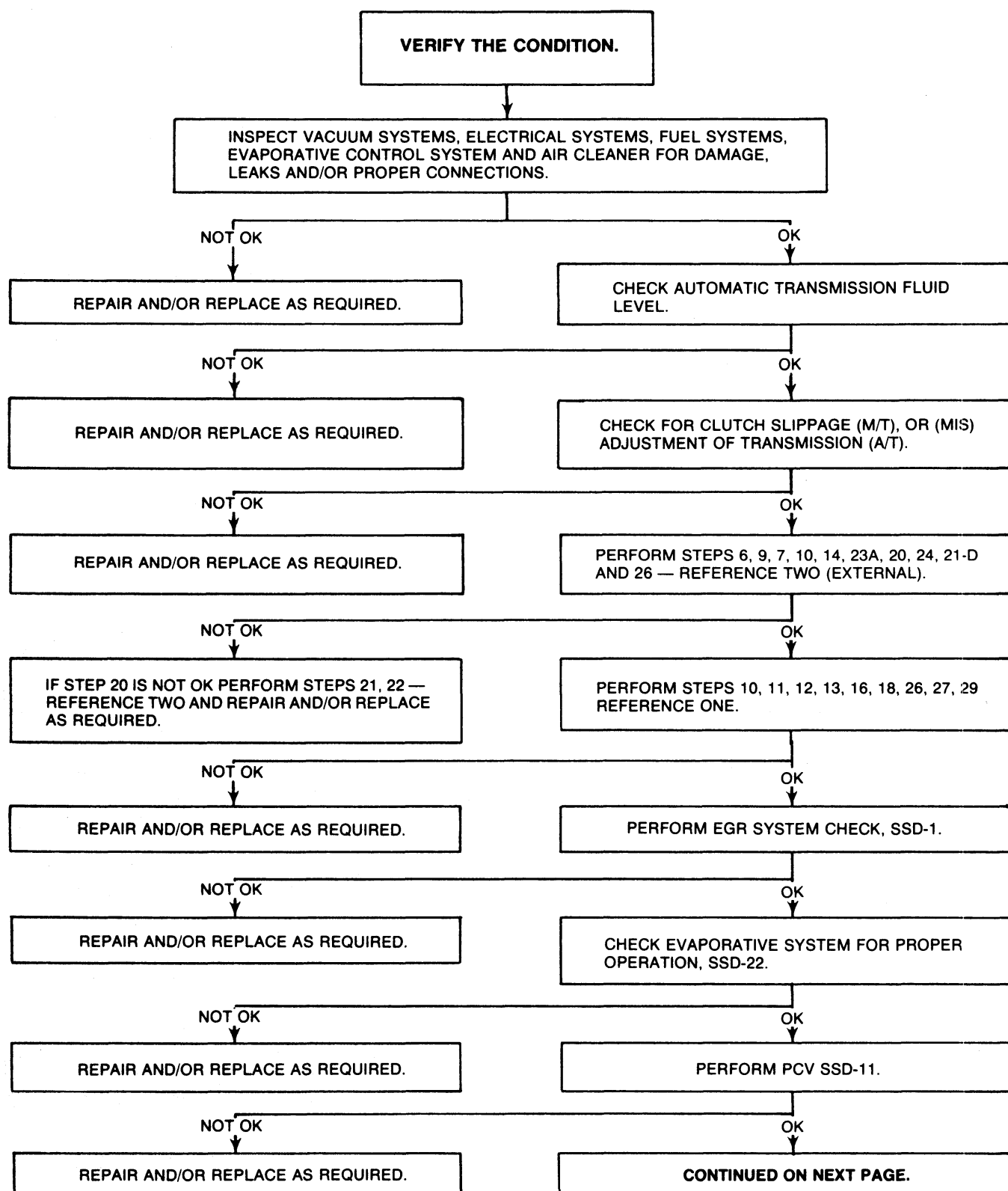
ROUTINE NO. 115 ENGINE HAS POOR ACCELERATION



ROUTINE NO. 115 ENGINE HAS POOR ACCELERATION — CONTINUED

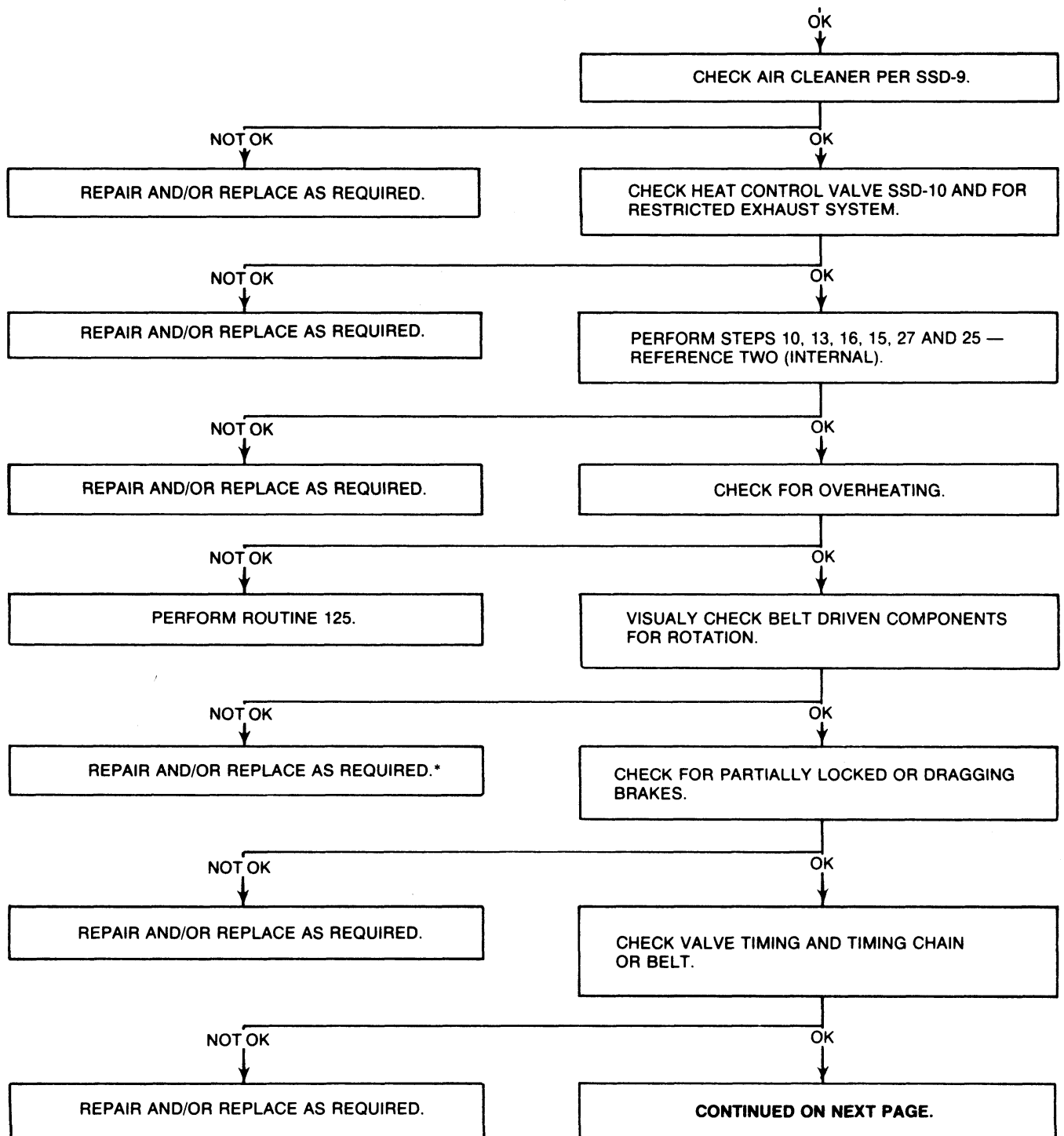


ROUTINE NO. 116 ENGINE HAS LESS THAN NORMAL POWER



ROUTINE NO. 116

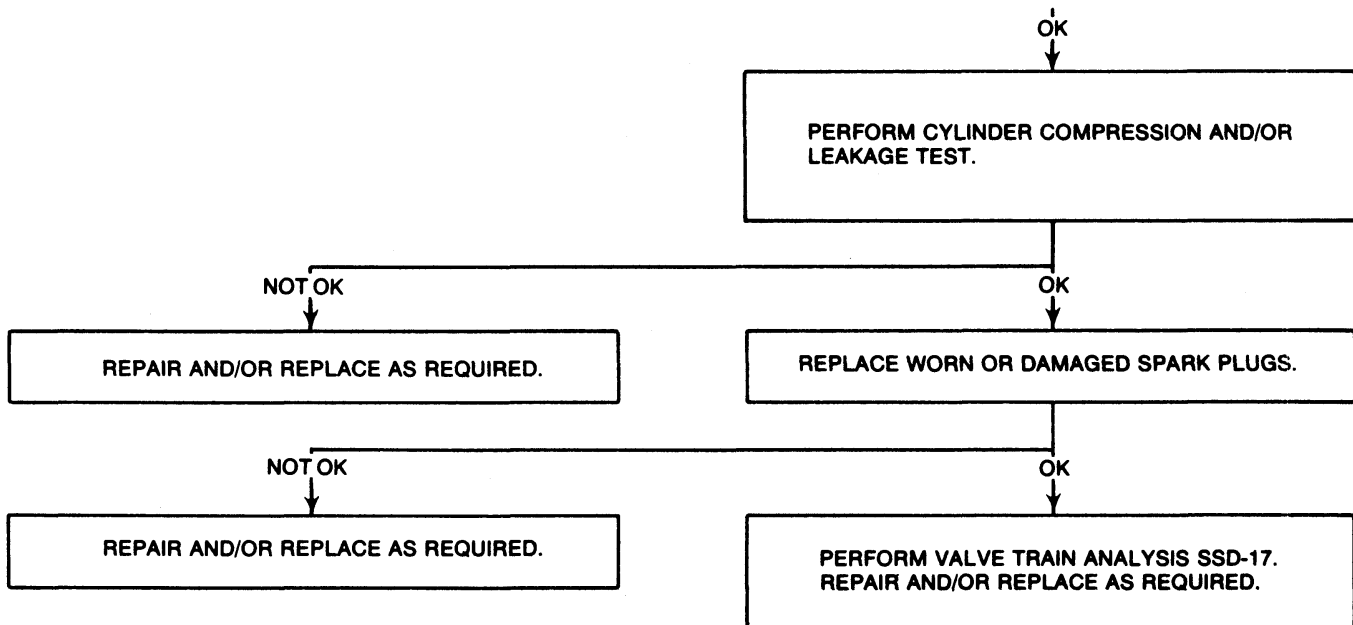
ENGINE HAS LESS THAN NORMAL POWER — CONTINUED



*IF THERMACTOR PUMP BELT.

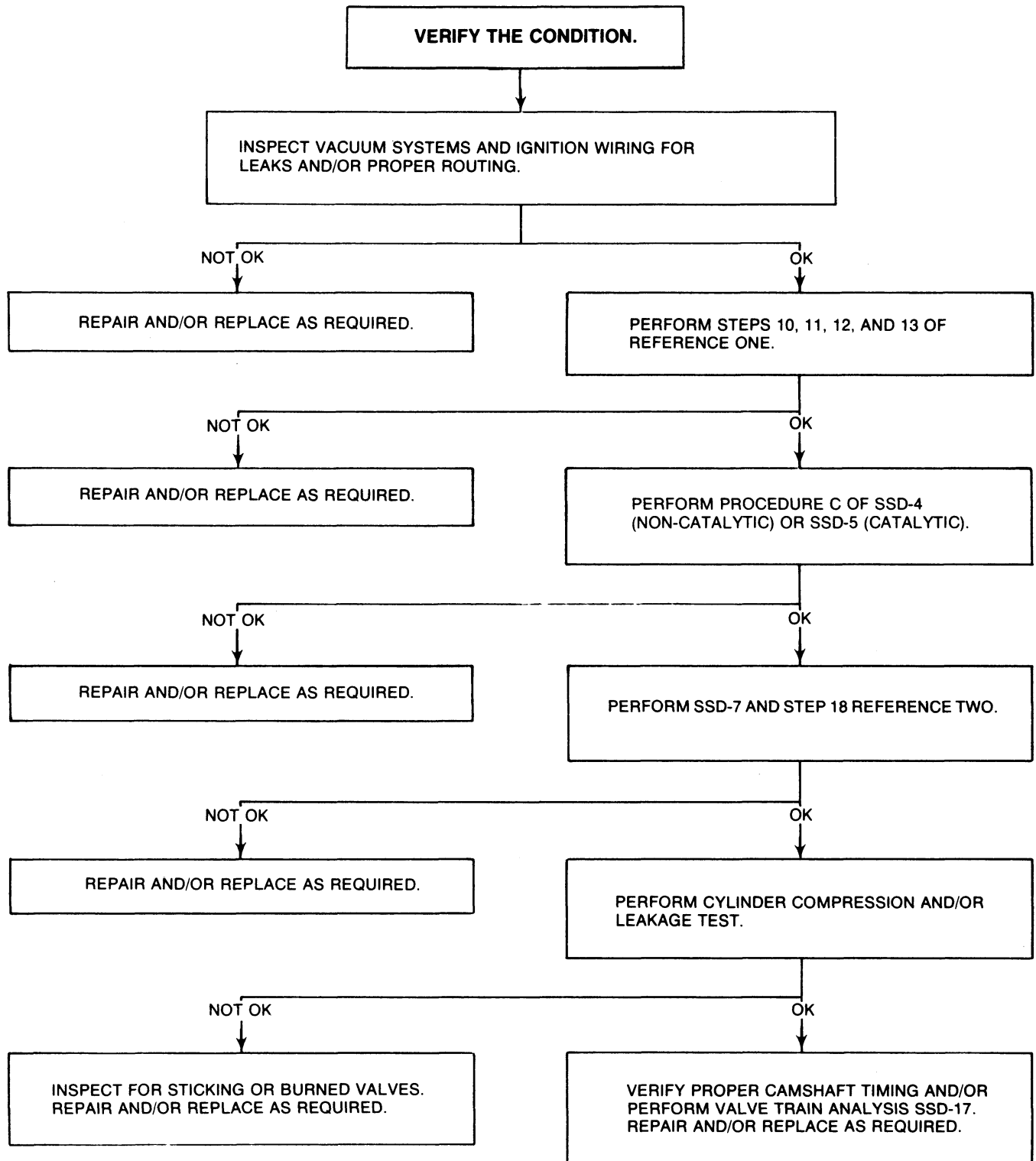
ROUTINE NO. 116

ENGINE HAS LESS THAN NORMAL POWER — CONTINUED



CA4359-2C3

ROUTINE NO. 117 EXHAUST SYSTEM BACKFIRE



ROUTINE NO. 118 ENGINE SURGES

VERIFY THE CONDITION.

INSPECT VACUUM SYSTEMS, ELECTRICAL SYSTEMS, FUEL SYSTEM,
EVAPORATIVE CONTROL SYSTEM, AND AIR CLEANER FOR DAMAGE,
BLOCKAGES, LEAKS, AND/OR PROPER CONNECTIONS.

NOT OK

REPAIR AND/OR REPLACE AS REQUIRED.

OK

PERFORM COMPRESSION BALANCE
(ELECTRICAL) STEP 17 REFERENCE ONE

NOT OK

PERFORM CYLINDER COMPRESSION AND/OR
LEAKAGE TEST.

OK

PERFORM SSD-3 SPARK CONTROL SYSTEMS
AND SPARK DELAY VALVE.

NOT OK

PERFORM STEP 25 OF REFERENCE TWO AND
REPAIR AND/OR REPLACE AS REQUIRED.

OK

PERFORM EGR SYSTEM CHECK SSD-1.

NOT OK

REPAIR AND/OR REPLACE AS REQUIRED.

OK

CHECK EVAPORATIVE EMISSION SYSTEM FOR
PROPER OPERATION, SSD-22.

NOT OK

REPAIR AND/OR REPLACE AS REQUIRED.

OK

PERFORM SSD-11.

NOT OK

PERFORM SSD-11 STEPS I-D, AND II. REPAIR
AND/OR REPLACE AS REQUIRED.

OK

PERFORM STEPS 6, 9, 10, 14, 22, 23 AND 26 OF
REFERENCE TWO (EXTERNAL).

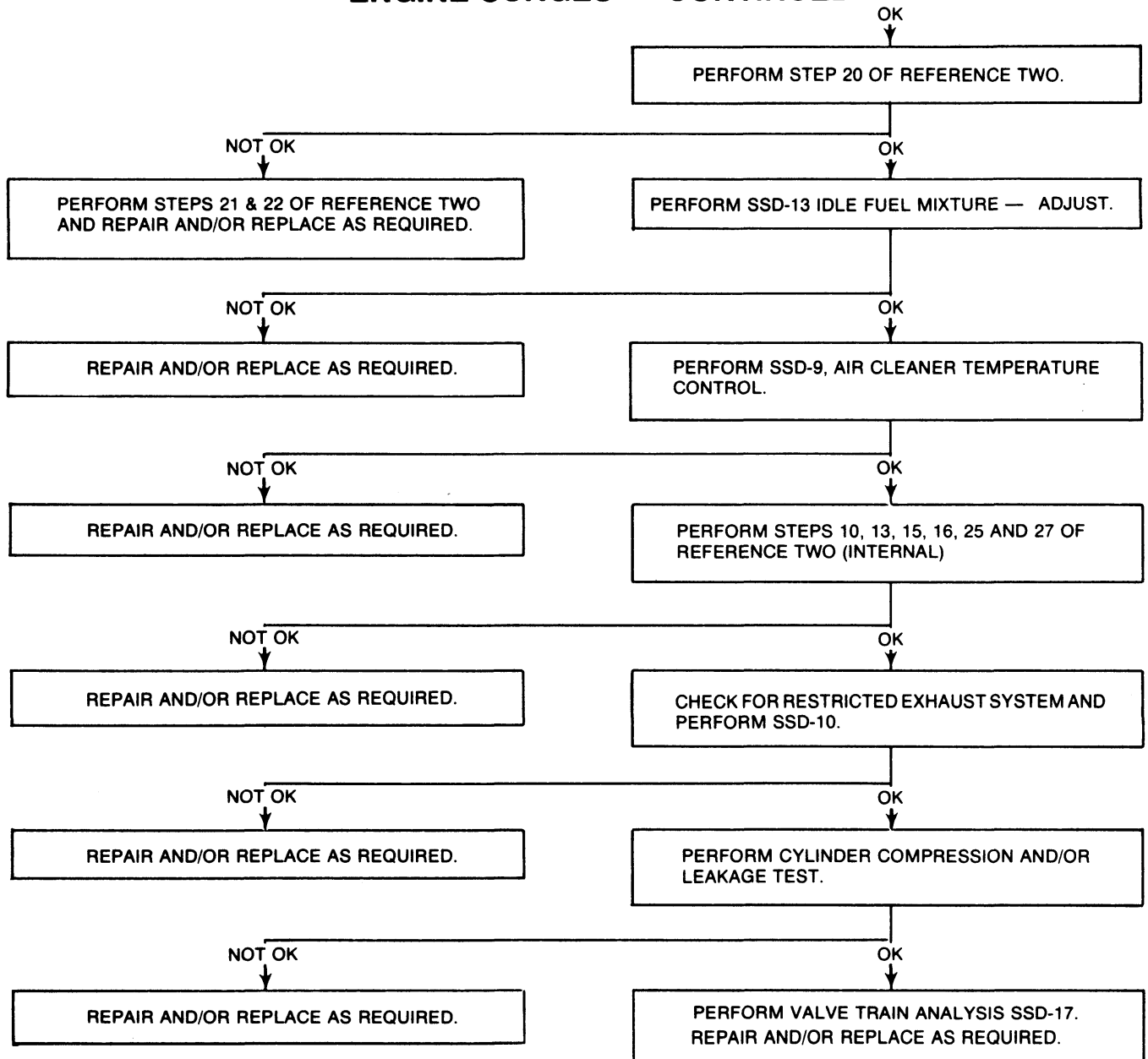
NOT OK

PERFORM STEP 23 OF REFERENCE TWO (IF
APPLICABLE) AND REPAIR AND/OR REPLACE AS
REQUIRED.

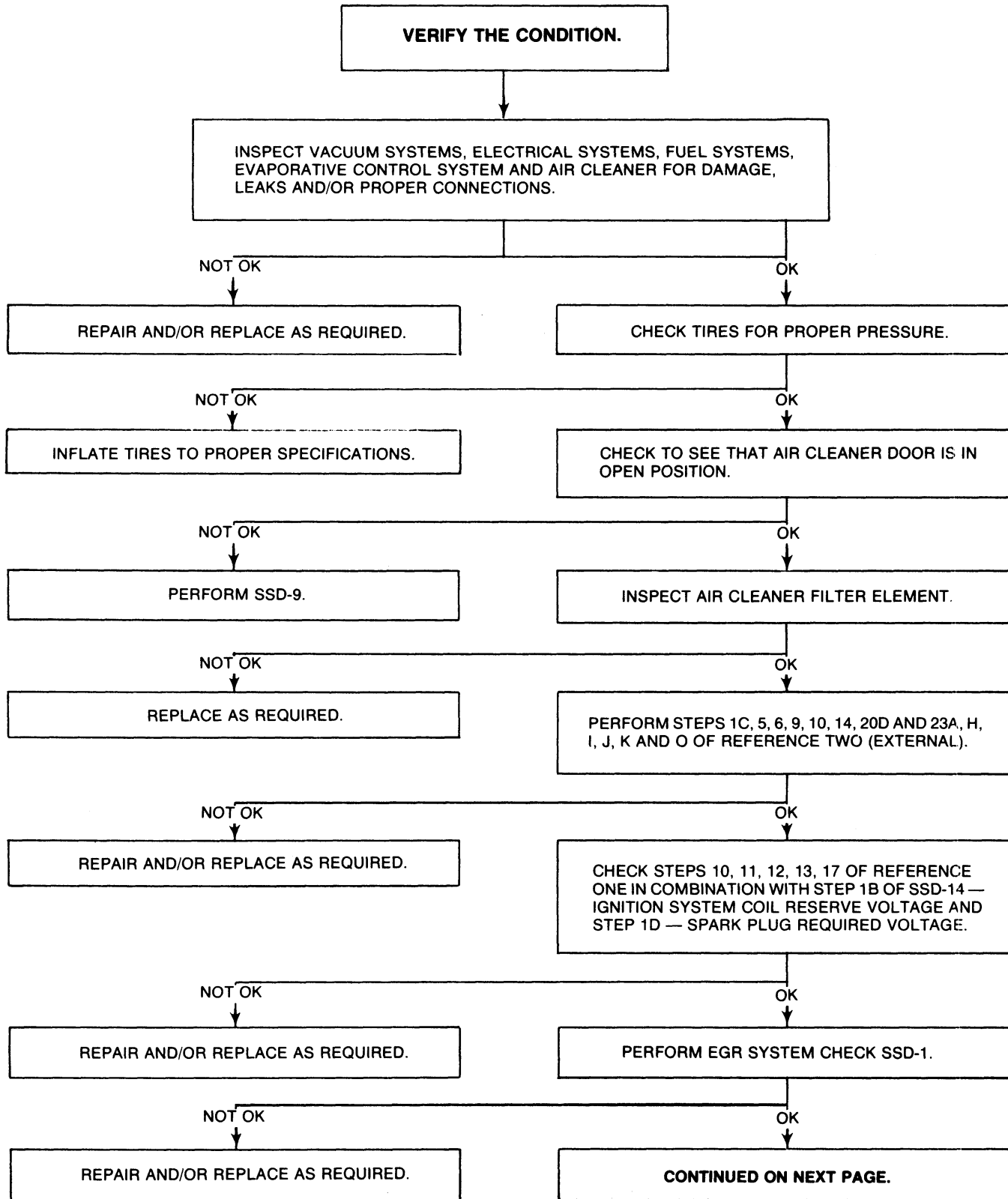
OK

CONTINUED ON NEXT PAGE.

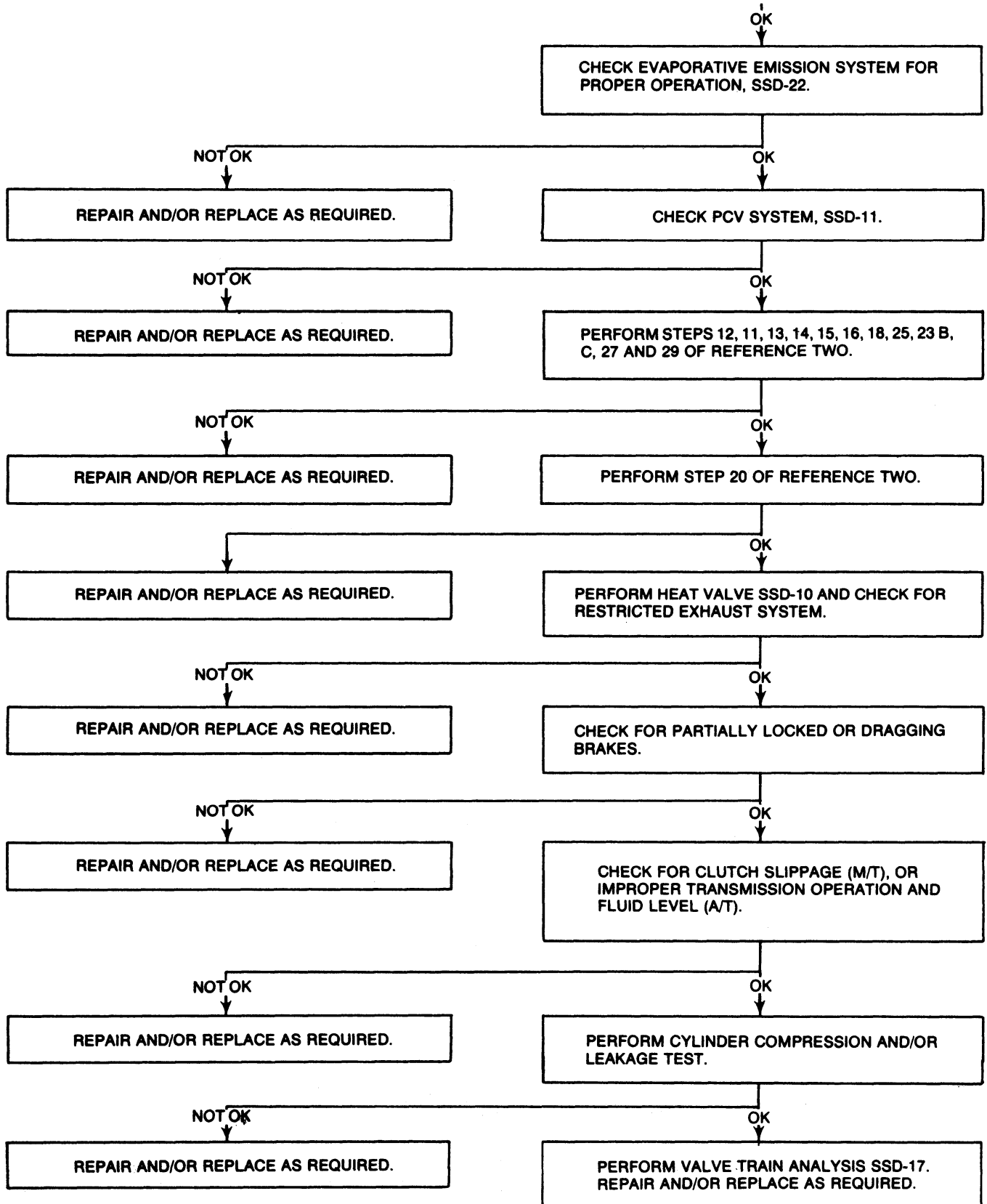
ROUTINE NO. 118 ENGINE SURGES — CONTINUED



ROUTINE NO. 119 EXCESSIVE FUEL CONSUMPTION



ROUTINE NO. 119 EXCESSIVE FUEL CONSUMPTION — CONTINUED



ROUTINE NO. 120**EXCESSIVE OIL CONSUMPTION****VERIFY THE CONDITION**

THE MOST COMMON CAUSE OF OIL LOSS IS LEAKAGE. TO VERIFY AN EXCESSIVE OIL CONSUMPTION COMPLAINT, IT IS NECESSARY THAT A THOROUGH INSPECTION BE MADE TO INSURE THAT LEAKAGE DOES NOT EXIST. THE FOLLOWING STEPS SHOULD BE FOLLOWED TO VERIFY AN EXCESSIVE OIL CONSUMPTION COMPLAINT:

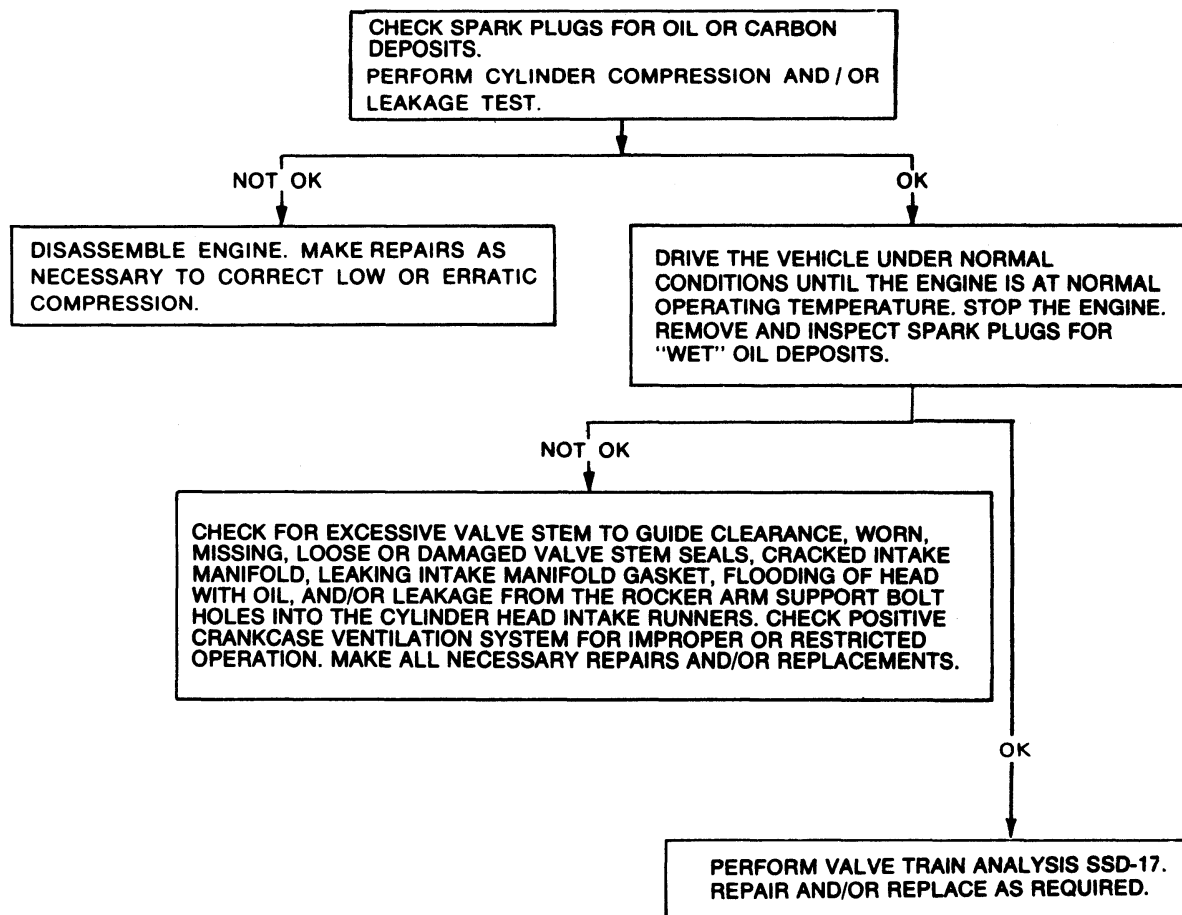
- A. STEAM CLEAN THE ENGINE (IF NECESSARY) TO REMOVE ACCUMULATED DIRT AND/OR OIL.
- B. DRAIN ENGINE OIL AND CHANGE THE OIL FILTER.
- C. FILL THE CRANKCASE WITH THE SPECIFIED AMOUNT OF THE RECOMMENDED GRADE OF OIL. (CHECK TO BE SURE THE CORRECT DIPSTICK HAS BEEN INSTALLED.)
- D. PERFORM POSITIVE CRANKCASE VENTILATION SYSTEM SSD-11 PART I A, B, C, D.
- E. WITH THE VEHICLE ON A LEVEL SURFACE, PLACE A CLEAN PAPER UNDER THE ENGINE (TO AID IN DETECTING LEAKAGE) AND OPERATE THE ENGINE FOR APPROXIMATELY 20 MINUTES AT 1200 RPM WITH THE TRANSMISSION IN NEUTRAL.
- F. SHUT OFF ENGINE AND CHECK FOR LEAKAGE AT:
 - 1. VALVE ROCKER ARM COVER GASKETS.
 - 2. OIL PAN GASKET.
 - 3. CYLINDER BLOCK FRONT COVER GASKET.
 - 4. CYLINDER BLOCK TO FUEL PUMP GASKET AND FUEL PUMP AIR VENT.
 - 5. INTAKE MANIFOLD SEALS.
 - 6. CRANKSHAFT SEALS.
 - 7. DISTRIBUTOR HOUSING O-RING.
 - 8. OIL FILTER
 - 9. OIL PRESSURE SENDING UNIT.
- G. WHEN ALL CAUSES OF LEAKAGE (IF ANY) HAVE BEEN REPAIRED, CHECK THE OIL LEVEL AND USE A FILE OR CENTER PUNCH TO MARK THE DIPSTICK AT THE INDICATED LEVEL.
- H. RECORD THE ODOMETER READING. HAVE THE CUSTOMER OPERATE THE ENGINE FOR THE APPROXIMATE NUMBER OF MILES INDICATED BY THE COMPLAINT AND THEN RETURN IT TO YOU FOR EXAMINATION.
- I. WHEN CUSTOMER RETURNS THE VEHICLE, VERIFY THE ODOMETER READING, CHECK THE OIL LEVEL, AND RE-INSPECT THE ENGINE FOR SIGNS OF OIL LEAKAGE.
- J. ADD A MEASURED AMOUNT OF OIL AS NECESSARY TO BRING THE OIL LEVEL TO THE PREVIOUSLY INSCRIBED MARK ON THE DIPSTICK.
- K. IF OIL CONSUMPTION IS NOT WITHIN SPECIFIED LIMITS, PROCEED WITH OIL CONSUMPTION DIAGNOSIS AS OUTLINED BELOW.

NOTE: A NEW ENGINE MAY REQUIRE UP TO 6,000 MILES OF OPERATION IN ORDER TO PROPERLY SEAT (BREAK IN) THE PISTON RINGS. FOR THIS REASON, THE ENGINE SHOULD NOT BE CONDEMNED AS LONG AS OIL ECONOMY IS IMPROVING WITH MILEAGE ACCUMULATION. IF OIL ECONOMY CEASES TO IMPROVE WITH MILEAGE ACCUMULATION CORRECTIVE ACTION SHOULD BE TAKEN.

CONTINUED ON NEXT PAGE

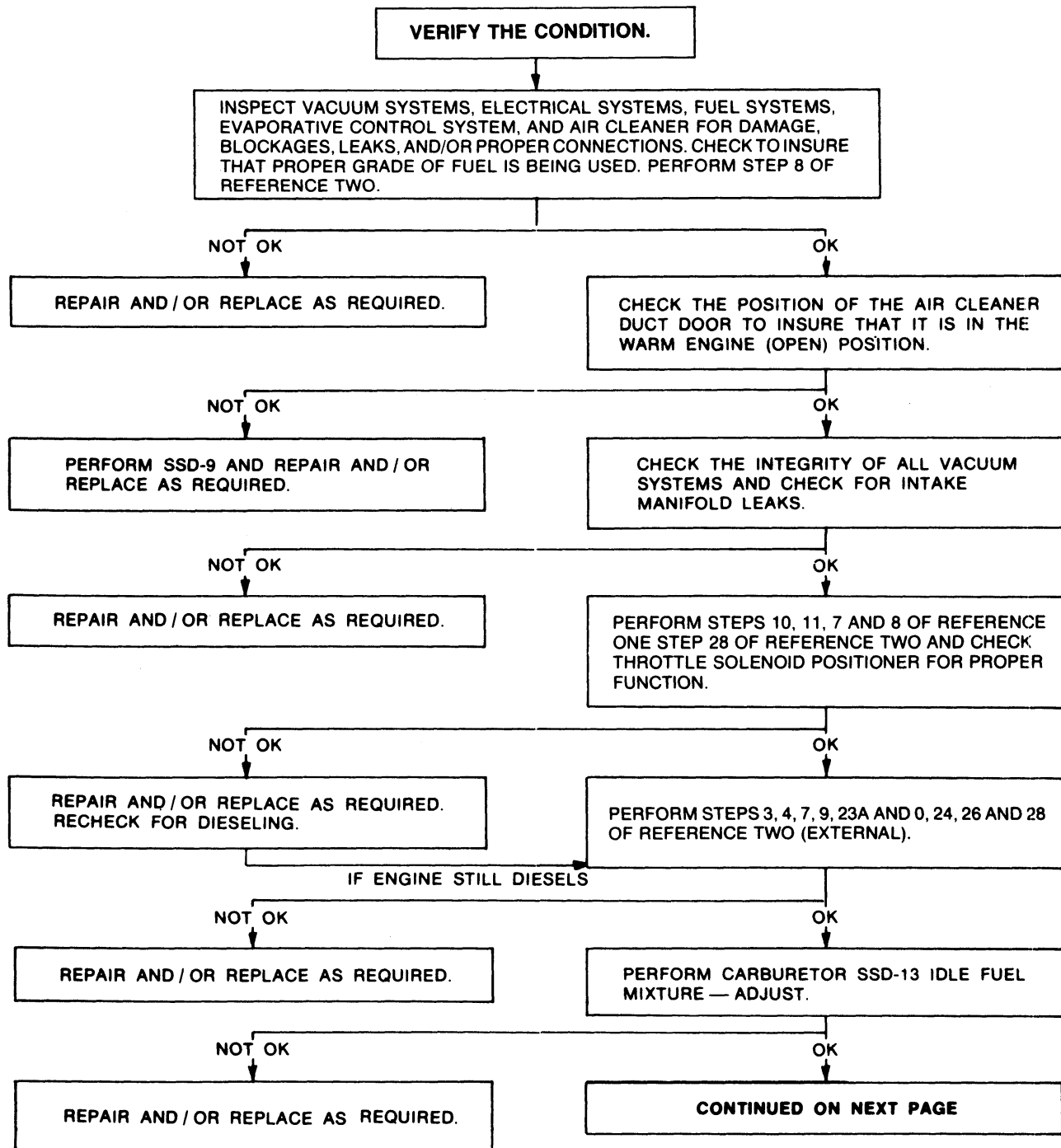
CA4363-2A1

ROUTINE NO. 120 — CONTINUED EXCESSIVE OIL CONSUMPTION

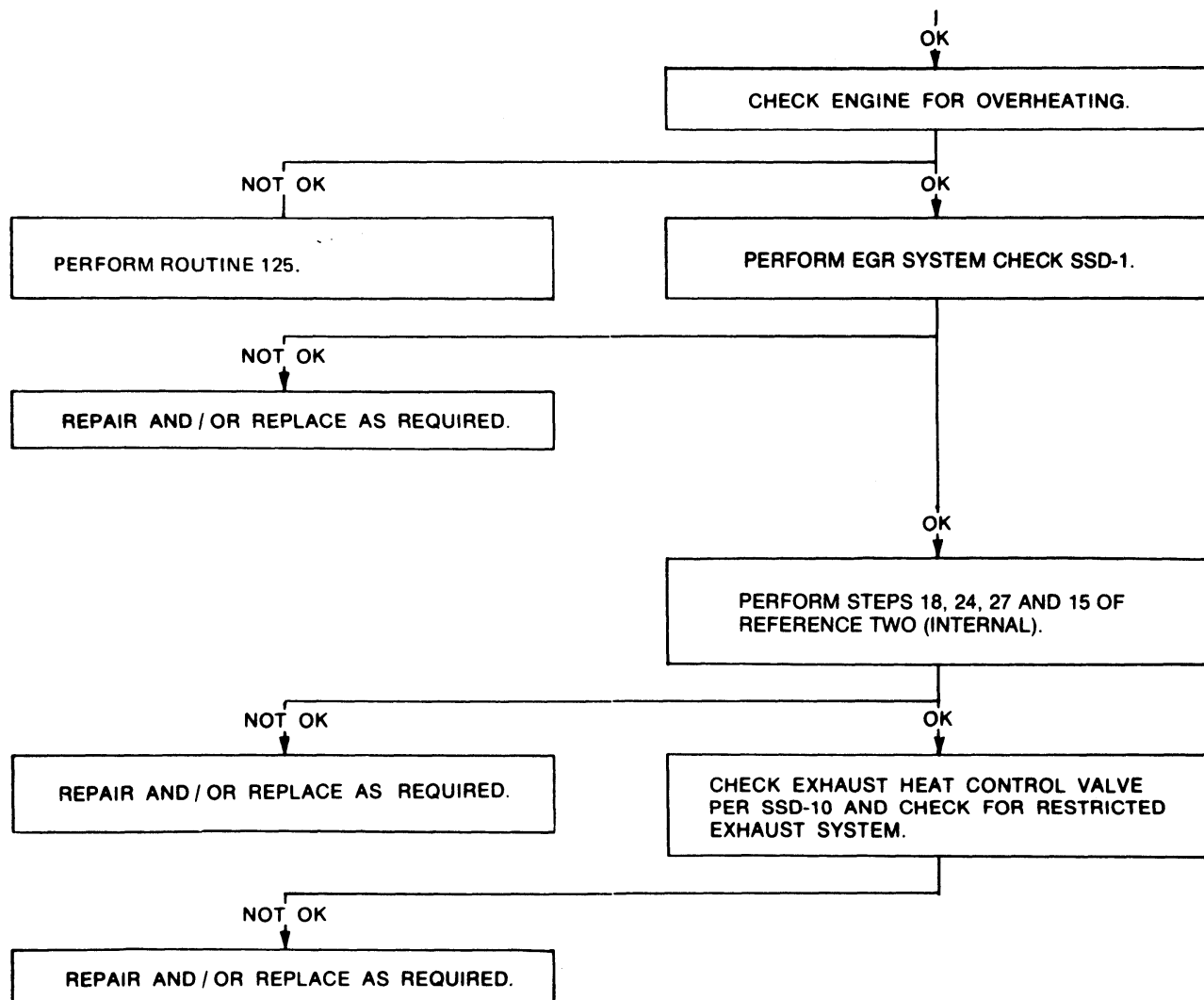


CA4363-2C2

ROUTINE NO. 121 ENGINE DIESELS — CONTINUES TO RUN AFTER SHUT OFF



**ROUTINE NO. 121
ENGINE DIESELS —
CONTINUES TO RUN AFTER SHUT OFF — CONTINUED**



CA4364-2D2

ROUTINE NO. 122

ENGINE NOISE

ENGINE NOISE COVERS A WIDE RANGE OF CONDITIONS. THE MOST EFFICIENT WAY OF CORRECTING THE CONDITION IS TO ACCURATELY IDENTIFY THE TYPE AND GENERAL LOCATION OF THE NOISE. THEN, PROCEED TO THE APPLICABLE STEP BELOW. MANY OF THE STEPS ARE BASED ON INDIVIDUAL INTERPRETATION. THEREFORE, IF THE MOST LIKELY STEP FAILED TO CORRECT THE CONDITION, PROCEED TO THE NEXT LIKELY STEP, AND SO ON.

A. THERMACTOR SYSTEM NOISE: (VEHICLES SO EQUIPPED)

THE THERMACTOR SYSTEM IS NOT COMPLETELY NOISELESS. UNDER NORMAL CONDITIONS NOISE RISES IN PITCH AS ENGINE SPEED INCREASES. TO DETERMINE IF EXCESSIVE NOISE IS THE FAULT OF THE THERMACTOR SYSTEM, DISCONNECT THE DRIVE BELT AND OPERATE THE ENGINE. IF THE NOISE DISAPPEARS, REFER TO SSD-5.

B. LIGHT CLICKING VARIES WITH ENGINE SPEED

CHECK ACCESSORY COMPONENTS AS SOURCE OF NOISE BY LOOSENING AND/OR REMOVING DRIVE BELTS ONE AT A TIME UNTIL NOISE STOPS. ALSO INVESTIGATE FUEL PUMP AND/OR FUEL PUMP DRIVE AS THE POSSIBLE CAUSE. IF NOISE CONTINUES, IT COULD BE CAUSED BY IMPROPERLY ADJUSTED, FAILED OR MALFUNCTIONING VALVE TRAIN COMPONENTS. INSERT FEELER GAUGE BETWEEN ROCKER ARM AND VALVE STEM TIP AND/OR EXERT PRESSURE ON ROCKER ARM. IF NOISE IS ELIMINATED ADJUST VALVE TIP CLEARANCE TO SPECIFICATION (WHERE APPLICABLE). IF CONDITION PERSISTS, INSPECT FOR WORN OR MALFUNCTIONING VALVE TRAIN COMPONENTS BY PERFORMING SSD-17. IF NO FAILURE IS DETECTED, CHECK FOR THE EFFECT OF EXCESSIVE VALVE STEM TO VALVE GUIDE CLEARANCE BY EXERTING SIDE PRESSURE ON VALVE STEM. IF DIAGNOSIS INDICATES THAT THE CLEARANCE RESULTS IN OBJECTIONABLE NOISE, AND THE SPECIFIED SERVICE CLEARANCE (MEASURED WITH A SERVICE TOOL) HAS BEEN EXCEEDED, THE GUIDE BORES SHOULD BE REAMED TO ACCEPT OVERSIZE VALVES AND/OR GUIDE BUSHINGS.

C. SHARP RAPPING — VARIES WITH ENGINE SPEED

USUALLY CAUSED BY A MALFUNCTIONING HYDRAULIC LIFTER AND MAY BE LOCATED WITH THE AID OF A STETHOSCOPE. IF UNABLE TO ISOLATE THE CAUSE OF THE NOISE WITH THE AID OF A STETHOSCOPE, INSTALL A ROTUNDA DIAGNOSTIC CONSOLE NO. 360036 OR EQUIVALENT AND PERFORM A GENERAL SCOPE AND POWER BALANCE CHECK TO FURTHER ATTEMPT TO ISOLATE AND CORRECT THE NOISE CONDITION. IF THE CONDITION STILL ISN'T CORRECTED, PERFORM STEP C, ABOVE.

D. HISSING

INSPECT VACUUM SYSTEMS FOR LEAKAGE DUE TO LOOSE CONNECTIONS AND/OR FAILED PARTS. INSPECT MANIFOLD FOR LEAKS. PERFORM CYLINDER COMPRESSION AND/OR LEAKAGE TESTS TO IDENTIFY AND ISOLATE CYLINDER HEAD GASKET LEAKS. INSPECT FOR CARBURETOR GASKET LEAKS.

NOTE: IF NOISE IS ISOLATED TO THE EGR SYSTEM, PERFORM SSD-1. IF NOISE IS ISOLATED TO THE EVAPORATIVE EMISSION SYSTEM, PERFORM SSD-22.

E. SHARP SNAPPING NOISE DURING ACCELERATION

PERFORM STEPS 21, 22 AND 23 OF REFERENCE ONE FOR HIGH TENSION CIRCUIT LEAKAGE.

F. SQUEAKS AND/OR SQUEALS

LOOSEN DRIVE BELTS ONE AT A TIME TO DETERMINE IF ACCESSORY COMPONENTS OR WATER PUMP IS AT FAULT.

G. HEAVY SQUEAL DURING ACCELERATION

CHECK FOR ACCESSORY DRIVE BELT SLIPPAGE AND ADJUST TENSION OR REPLACE AS REQUIRED.

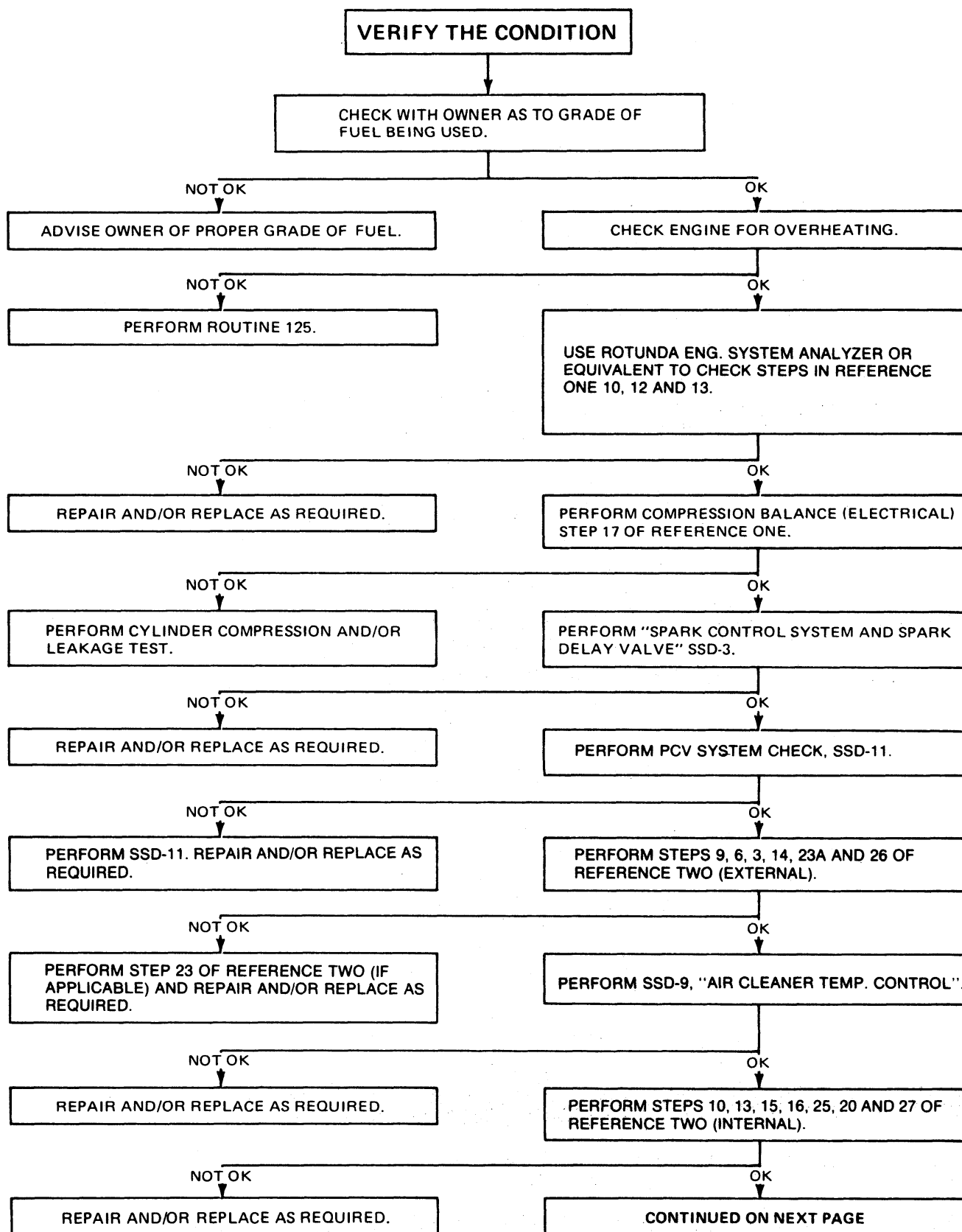
H. RINGING, GRINDING OR COMBINATION OF BOTH

CHECK FOR LOOSE, BENT OR IMPROPER PULLEYS, CHECK FOR FRONT END BRACKET INTERFERENCE BETWEEN ROTATING PARTS AND SURROUNDING COMPONENTS CAUSED BY MISALIGNMENT OF ENGINE, ENGINE COMPONENTS, OR SURROUNDING COMPONENTS. CHECK FOR WORN OR DAMAGED WATER PUMP OR ACCESSORY COMPONENTS BY LOOSENING DRIVE BELTS ONE AT A TIME UNTIL NOISE STOPS.

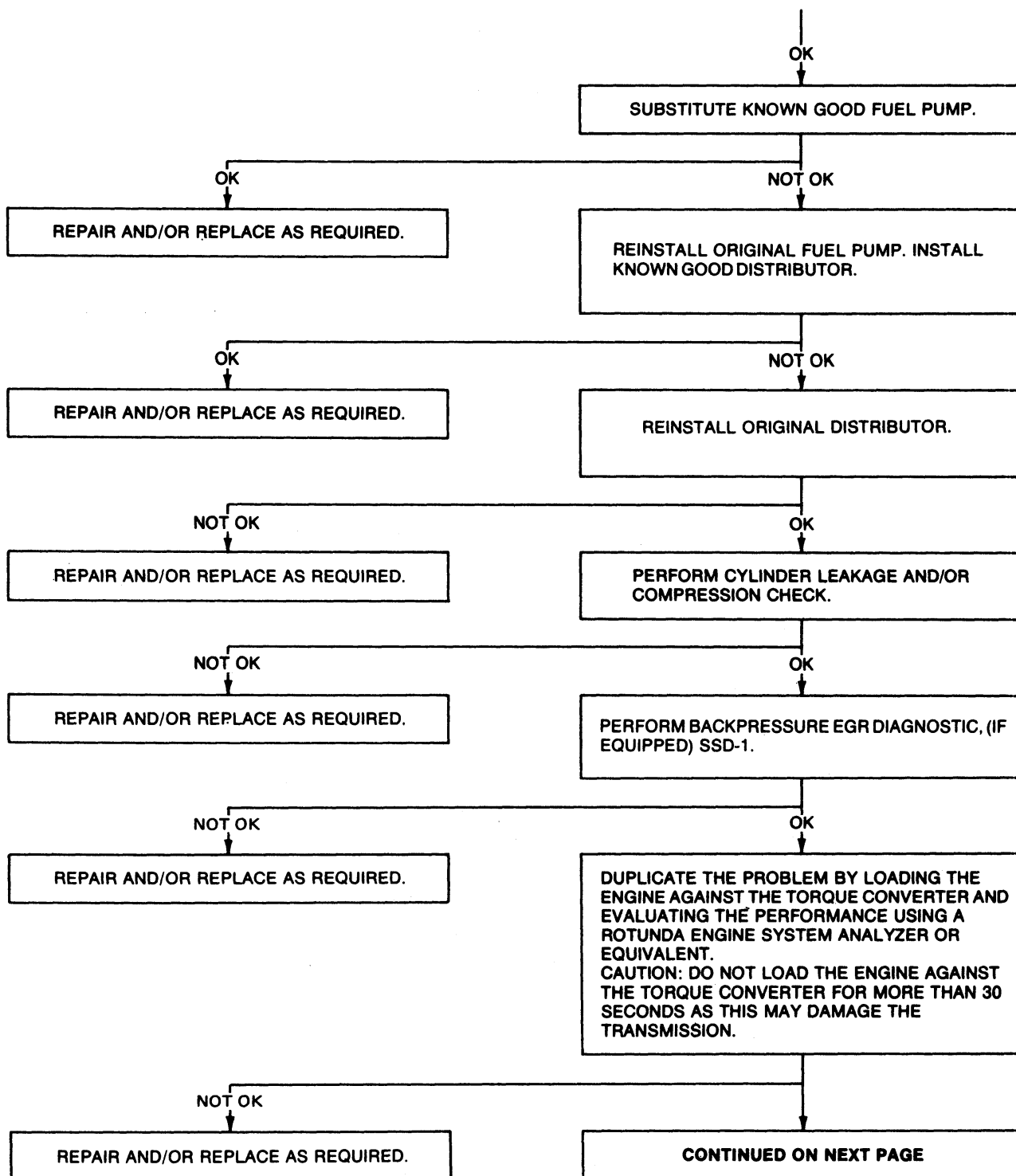
I. BUZZING OR WHISTLING DURING ENGINE OPERATION

PERFORM RADIATOR CAP FUNCTIONAL CHECK AND VERIFY PROPER CAP SEALING. IF ENGINE OVERHEATING IS INDICATED, PERFORM ROUTINE 125. CHECK FOR INTERFERENCE WITH THE FAN OR FRONT END DRIVE COMPONENTS BY FOREIGN MATERIAL OR LOOSE, OR BROKEN SURROUNDING PARTS. CHECK FOR LOOSE CARBURETOR MOUNTING. CHECK FOR VACUUM LEAKS, CHECK POWER STEERING. CHECK BACKPRESSURE EGR (IF SO EQUIPPED), SYSTEM SSD-1.

ROUTINE NO. 122A SPARK KNOCK OR PINGING

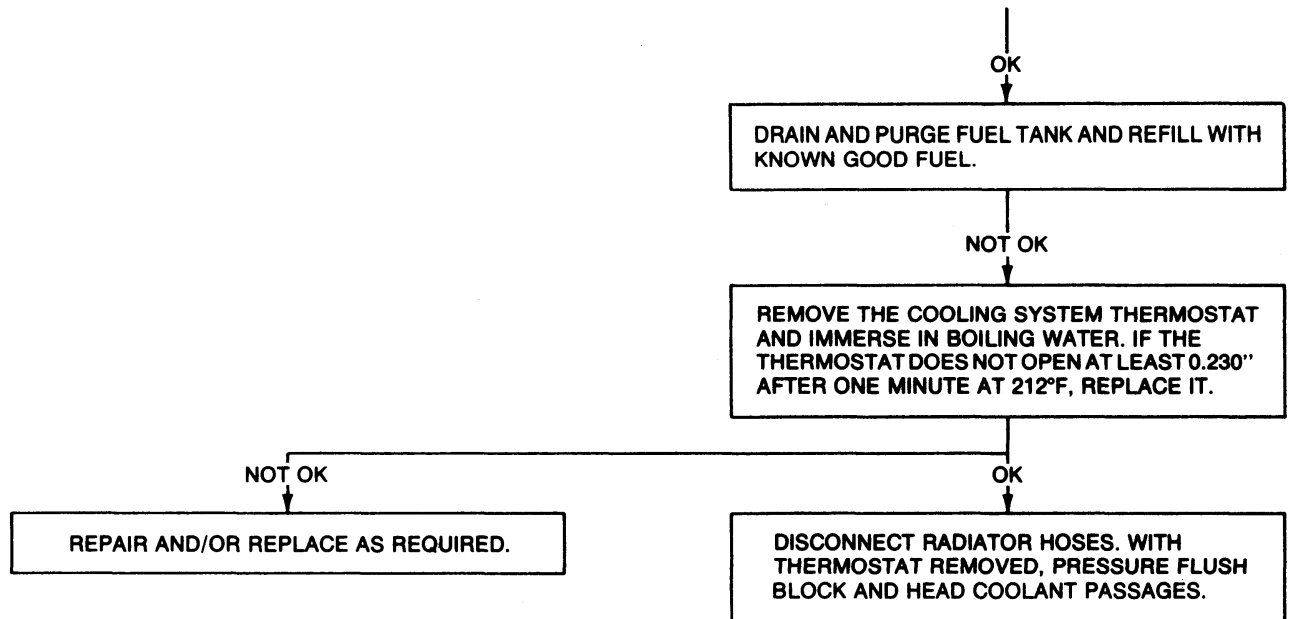


ROUTINE NO. 122A SPARK KNOCK OR PINGING — CONTINUED



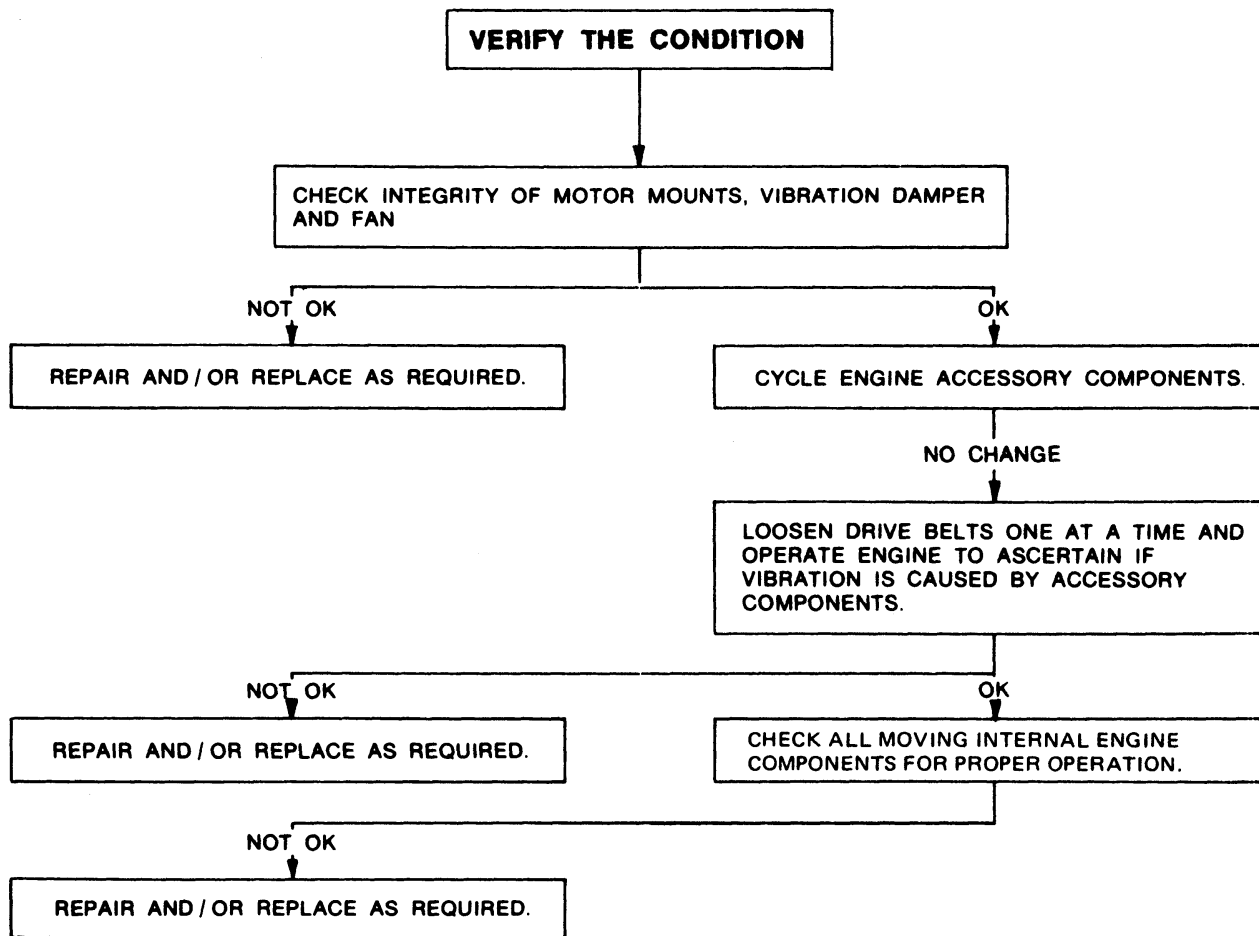
ROUTINE NO. 122A

SPARK KNOCK OR PINGING—CONTINUED



CA4366-2B3

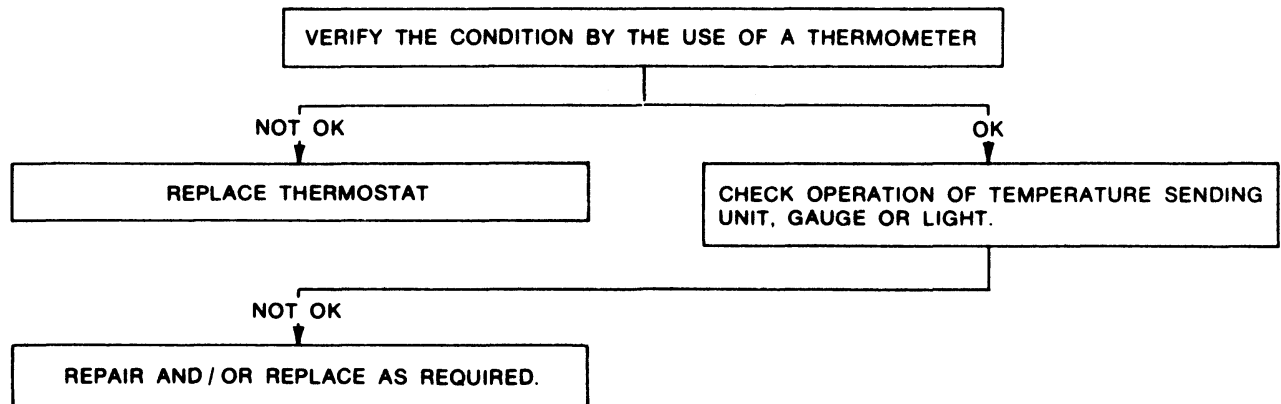
ROUTINE NO. 123 ENGINE VIBRATION



CA4367-2A

ROUTINE NO. 124

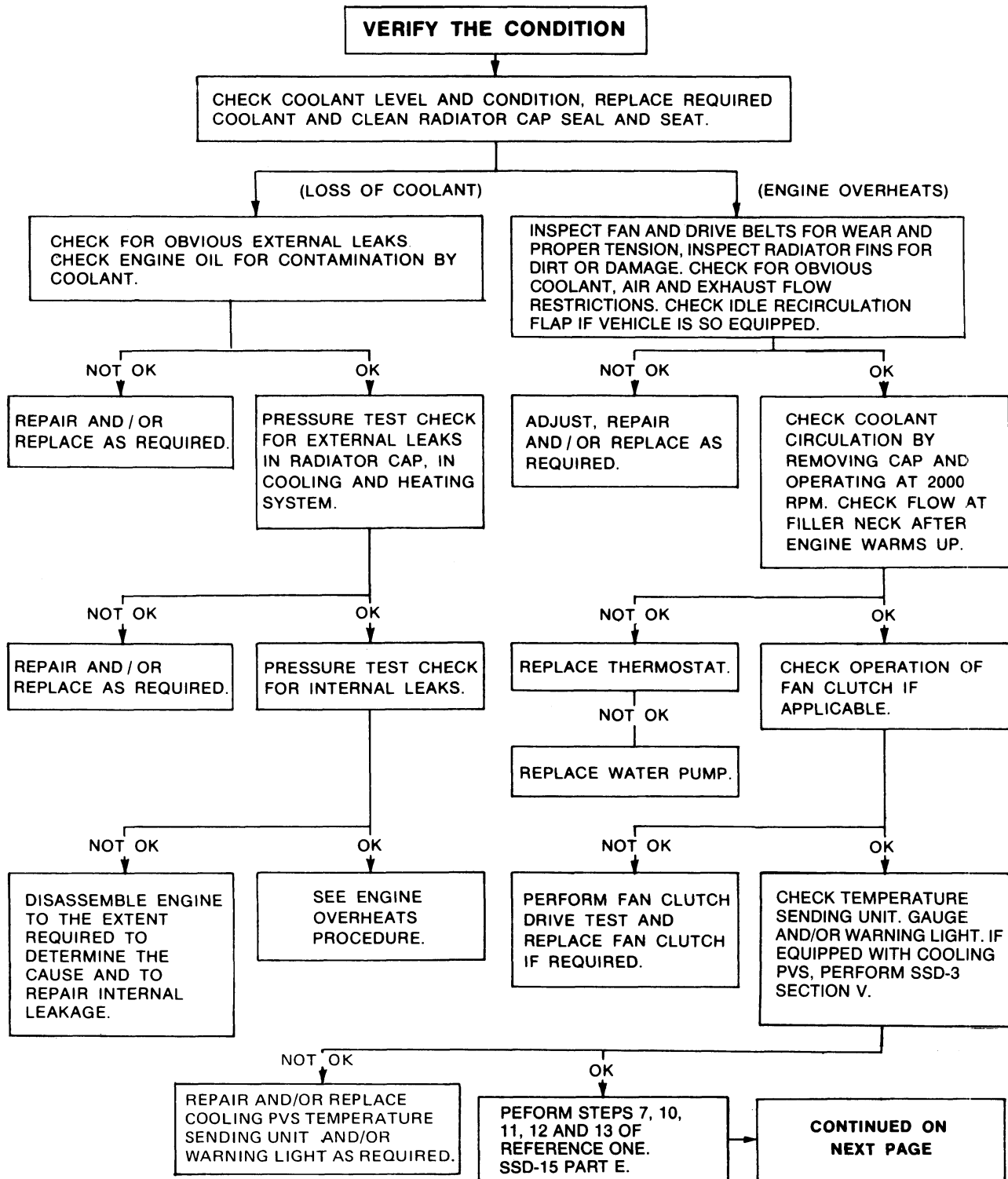
ENGINE FAILS TO REACH NORMAL OPERATING TEMPERATURE



CA4368-2A

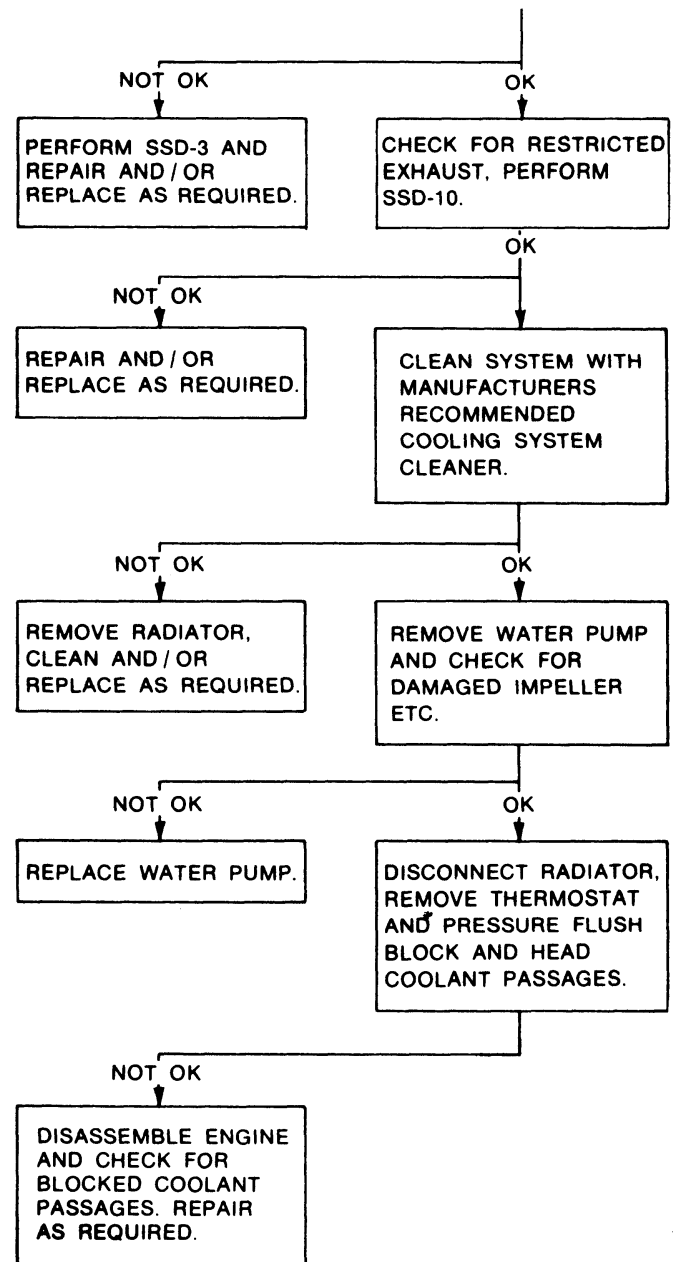
ROUTINE NO. 125

LOSS OF COOLANT OR ENGINE OVERHEATING



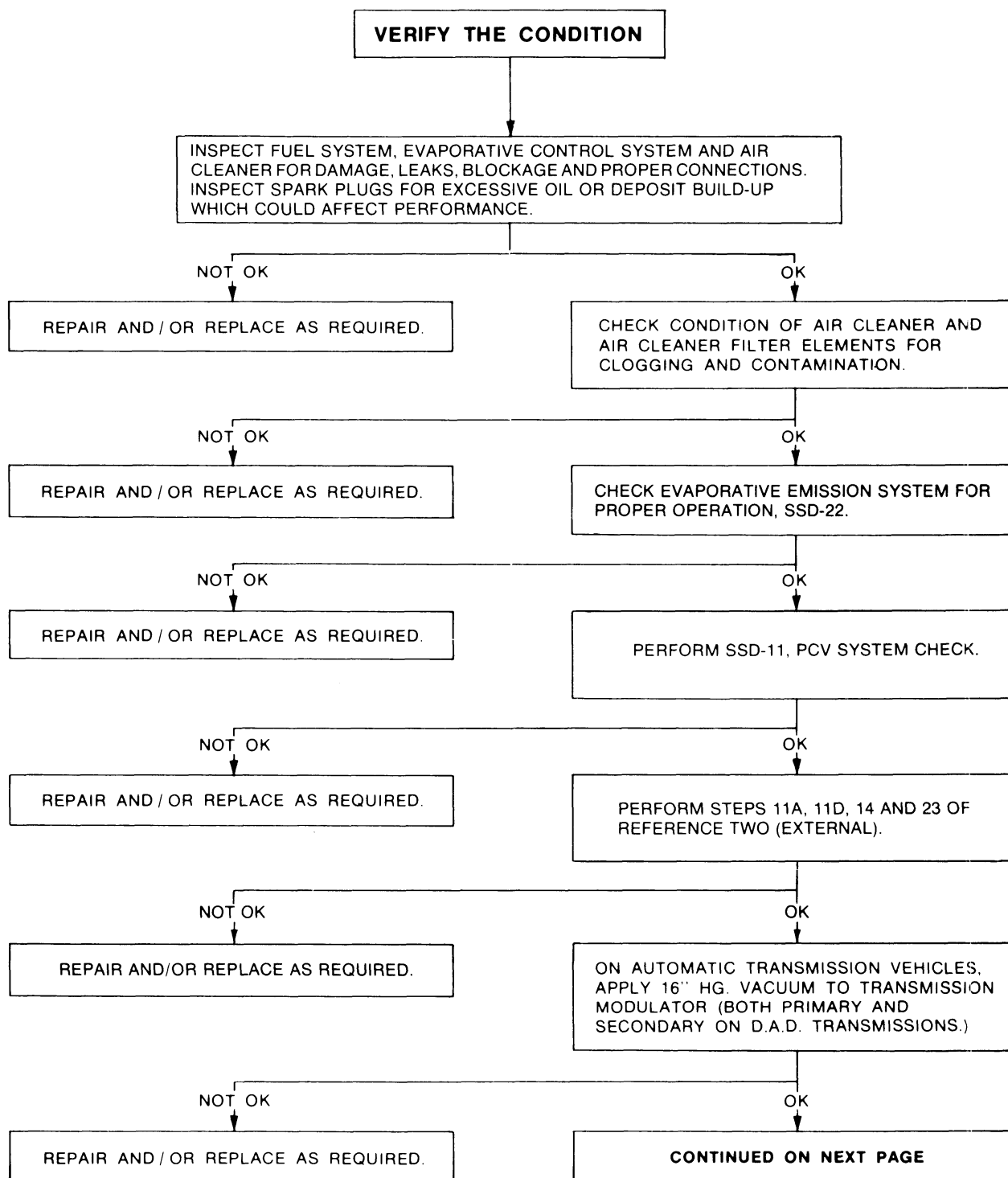
ROUTINE NO. 125

LOSS OF COOLANT OR ENGINE OVERHEATING — CONTINUED



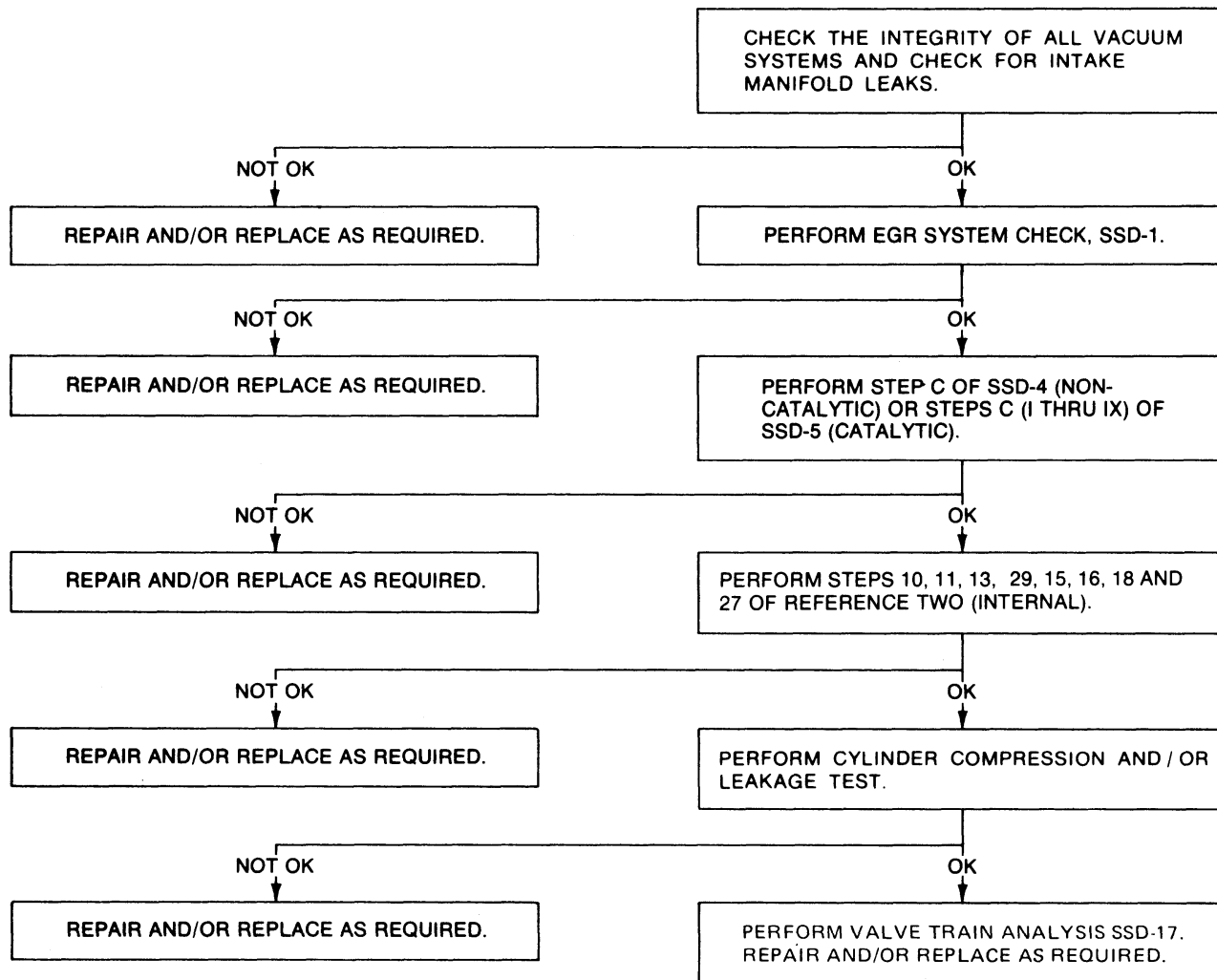
ROUTINE NO. 126

SMOKE FROM VEHICLE EXHAUST SYSTEM



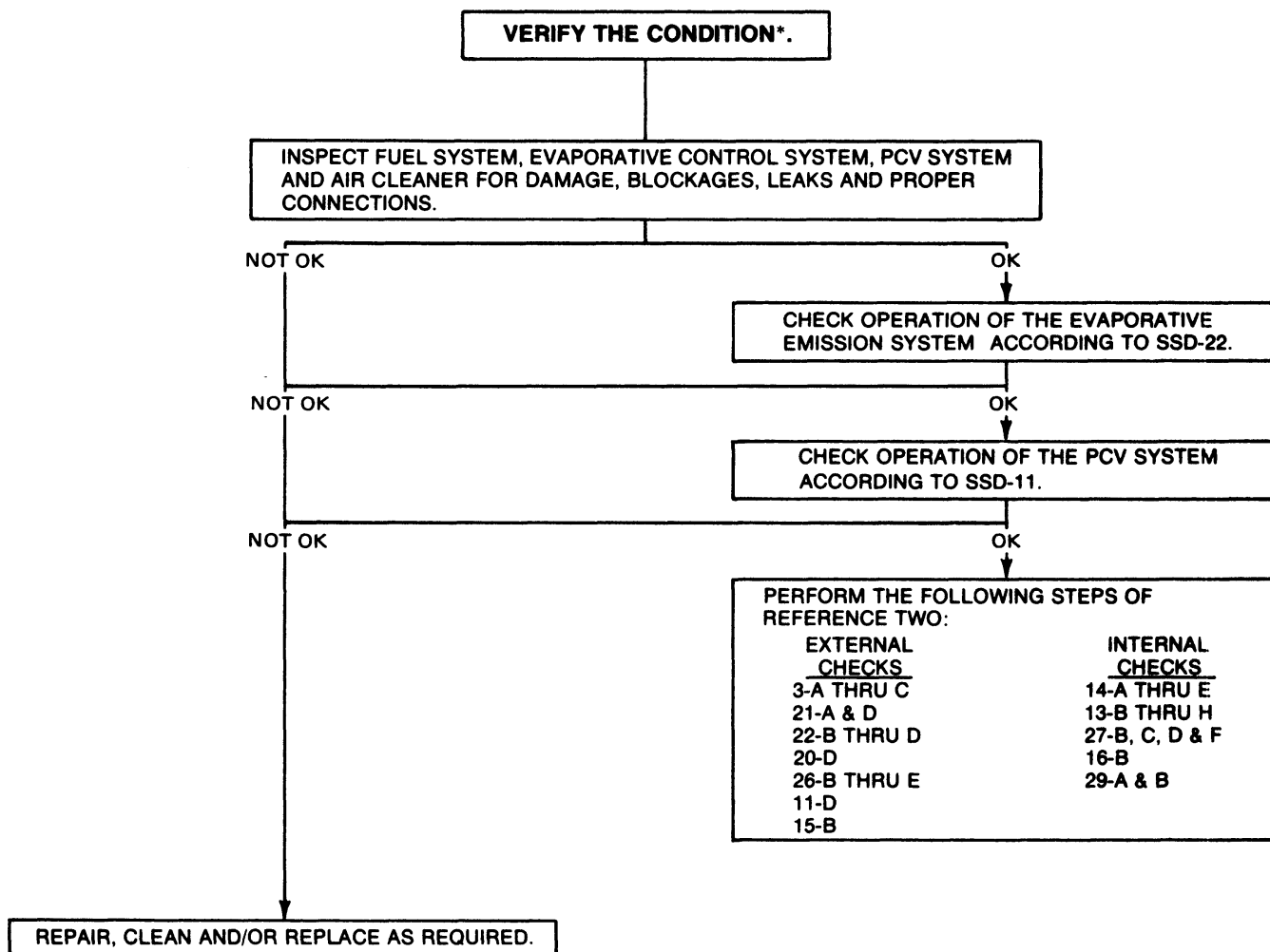
ROUTINE NO. 126

SMOKE FROM VEHICLE EXHAUST SYSTEM — CONTINUED



CA4370-2D2

ROUTINE NO. 129 GASOLINE ODOR PRESENT



*IF THE CONDITION EXISTS DURING START-UP, VERIFY THE CONDITION USING THE CORRECT STARTING PROCEDURE AND CHECK FOR FLOODING.

REFERENCE ONE

1. Check battery using Rotunda tester or equivalent.
2. Check starter draw.
3. Check battery voltage during cranking.
4. Check cranking speed.
5. Check basic timing while cranking.
6. Check spark plug firing voltage while cranking.
7. Check low idle speed with and without TSP
NOTE: When idle speed is adjusted, also perform fuel bowl vent procedure. SSD-16.
8. Check fast idle speed.
9. Check engine idle manifold vacuum.
10. Check basic timing — per SSD-15.
11. Check retard timing — per SSD-15.
12. Check mechanical advance — per SSD-15.
13. Check total advance at 2500 RPM — per SSD-15.
14. Check ignition coil primary voltage 1000 RPM (measured at “Bat” terminal).
15. Check battery voltage — 1000 RPM.
16. Check spark plug firing voltage per SSD-14 (loaded or on quick acceleration).
- *17. Check compression balance 1-8 cylinders (electrical — no EGR/mechanical).
- *18. Check ignition system coil reserve voltage — 1000 RPM, per SSD-14.
- *19. Check distributor rotor high voltage gap drop, per SSD-14.
20. Check coil and spark plug wire resistance, per SSD-14.
21. Inspect coil and spark plug wires and connections.
22. Check condition of cap and rotor.
23. Check ignition coil condition and operation, per SSD-14.
24. Check primary wiring in ignition system, per SSD-14.
25. Check charging rate to battery with engine operating at approximately 1000 RPM.
26. Check spark delay valve for correct installation and operation (SSD-2).
27. Use auxiliary vacuum source to check integrity of vacuum advance and retard diaphragm.
28. Check distributor dwell at normal engine idle and at 2000 RPM.

* On catalyst equipped vehicles, do not perform Steps 17, 18, and 19 until vehicle passes Step 16.

REFERENCE TWO

1. CHECK FUEL SUPPLY

- A. CHECK FOR FUEL AVAILABILITY
- B. CHECK FOR FUEL CONTAMINATION IN FUEL SUPPLY SOURCE AND FUEL LINES
- C. CHECK FOR FUEL LEAKS
- D. CHECK FOR DAMAGED PARTS IN FUEL SUPPLY SOURCE AND FUEL LINES

2. CHECK FUEL DELIVERY TO CARBURETOR

- A. CHECK FOR FUEL DELIVERY TO FILTER PRIOR TO REMOVING FILTER FROM CARBURETOR
- B. CHECK FOR FUEL DELIVERY THROUGH FILTER(S) TO CARBURETOR
- C. CHECK FOR FUEL PUMP LEAKS
- D. CHECK FOR PROPER ASSEMBLY
- E. CHECK FOR CONTAMINATION
- F. CHECK FOR DAMAGED PARTS

3. CHECK CARBURETOR VACUUM HOSES, FUEL LINES, AND PCV LINE

- A. CHECK FOR LEAKS
- B. CHECK FOR DAMAGED PARTS
- C. CHECK FOR PROPER ASSEMBLY
- D. CHECK FOR CONTAMINATION

4. CHECK ELECTRICAL CONNECTIONS

- A. CHECK FOR PROPER ASSEMBLY
- B. CHECK FOR SHORTED CIRCUIT
- C. CHECK FOR DAMAGED PARTS

5. CHECK CHOKE HEAT SUPPLY SYSTEM

- A. CHECK FOR AIR LEAKS
- B. CHECK FOR DAMAGED PARTS
- C. CHECK FOR PROPER ASSEMBLY
- D. CHECK FOR MISSING PARTS

6. CHECK AIR CLEANER

- A. CHECK FILTER ELEMENT(S) FOR CONTAMINATION
- B. CHECK HEAT CONTROL VALVE FOR FUNCTION PER SSD-9
- C. CHECK FOR DAMAGED PARTS
- D. CHECK FOR PROPER ASSEMBLY

7. CHECK THROTTLE LINKAGE AND THROTTLE PLATES

- A. CHECK FOR BINDING
- B. CHECK FOR FULL TRAVEL
- C. CHECK FOR PROPER ASSEMBLY
- D. CHECK FOR CONTAMINATION
- E. CHECK FOR DAMAGED PARTS

8. CHECK ENGINE SPEED ADJUSTMENTS

- A. CHECK CURB IDLE SPEED.
- B. CHECK DE-ENERGIZED SOLENOID SPEED
- C. CHECK FAST IDLE SPEED

9. CHECK SECONDARY THROTTLE LINKAGE AND CHOKE LOCKOUT LINKAGE

- A. CHECK FOR LINKAGE BINDING
- B. CHECK FOR DAMAGED PARTS
- C. CHECK FOR PROPER ASSEMBLY
- D. CHECK FOR CONTAMINATION

10. CHECK AIR VALVE PLATE, METERING NEEDLES AND/OR JETS

- A. CHECK FOR BINDING
- B. CHECK FOR DAMAGED PARTS
- C. CHECK FOR PROPER ASSEMBLY
- D. CHECK FOR CONTAMINATION

11. CHECK ACCELERATOR PUMP SYSTEM

- A. CHECK FOR FUEL DISCHARGE
- B. CHECK FOR BINDING
- C. CHECK FOR PROPER ADJUSTMENT
- D. CHECK FOR FUEL LEAK
- E. CHECK FOR CONTAMINATION
- F. CHECK FOR PROPER ASSEMBLY
- G. CHECK FOR DAMAGED PARTS

12. CHECK FOR FUEL IN FUEL BOWL

- A. USE FUEL GAUGE TO CHECK FOR FUEL IN BOWL (WHEN GAUGE IS AVAILABLE)
- B. CHECK FOR CONTAMINATION AND, IF REQUIRED, CLEAN CARBURETOR PER SSD-18
- C. DISASSEMBLE AND CHECK ITEM #13 AS REQUIRED

13. CHECK FUEL INLET SYSTEM COMPONENTS

- A. CHECK FOR CONTAMINATION AND, IF REQUIRED, CLEAN CARBURETOR PER SSD-18
- B. CHECK FOR BINDING
- C. CHECK FOR DAMAGE
- D. CHECK FOR PROPER ASSEMBLY
- E. CHECK FOR CORRECT FUEL LEVEL
- F. CHECK FOR FLOAT ALIGNMENT
- G. CHECK FLOAT FOR LEAKS

14. CHECK FUEL BOWL VENTS PER SSD-16

- A. CHECK FOR RESTRICTION
- B. CHECK FOR PROPER ADJUSTMENT
- C. CHECK FOR PROPER ASSEMBLY
- D. CHECK FOR BINDING

15. CHECK FUEL METERING SYSTEMS (IDLE & MAIN)

- A. CHECK FOR CONTAMINATION
- B. CHECK FOR FUEL LEAKS
- C. CHECK FOR AIR LEAKS
- D. CHECK FOR RESTRICTIONS
- E. CHECK FOR PROPER ASSEMBLY
- F. CHECK FOR DAMAGED PARTS
- G. CHECK FOR PROPER IDLE FUEL MIXTURE (SSD-13)

16. CHECK FUEL ENRICHMENT SYSTEM

- A. CHECK FOR AIR LEAK
- B. CHECK FOR FUEL LEAK
- C. CHECK FOR RESTRICTIONS
- D. CHECK FOR DAMAGED PARTS
- E. CHECK FOR PROPER ASSEMBLY
- F. CHECK FOR CONTAMINATION

18. CHECK FUEL DÉCELERATION SYSTEM

- A. CHECK FOR CONTAMINATION
- B. CHECK FOR RESTRICTION
- C. CHECK FOR PROPER ASSEMBLY
- D. CHECK FOR DAMAGED PARTS
- E. CHECK FOR PROPER ADJUSTMENT
- F. CHECK FOR AIR LEAKS

20. CHECK FUEL PUMP FUEL DELIVERY

- A. CHECK PRESSURE AND VOLUME WITH ORIGINAL FILTER
- B. CHECK PRESSURE AND VOLUME WITH NEW FILTER
- C. CHECK FOR CONTAMINATION
- D. CHECK FOR FUEL LEAK

21. CHECK FUEL TANK

- A. CHECK FOR LEAKS
- B. CHECK FOR SOURCES WHERE DIRT OR WATER MAY ENTER
- C. CHECK TANK FILTER AND PICK-UP FOR FUNCTION
- D. CHECK GAS TANK CAP FOR PROPER FUNCTION

22. CHECK FUEL LINES FROM TANK TO PUMP

- A. CHECK FOR CONTAMINATION
- B. CHECK FOR KINKS OR DAMAGED PARTS
- C. CHECK FOR LEAKS
- D. CHECK FUEL RETURN LINE IF EQUIPPED

23. CHECK CHOKE SYSTEM PER SSD-12

- A. CHECK PER SSD-12 LINKAGE SYSTEM
- B. CHECK PER SSD-12 HEAT SYSTEM
- C. CHECK PER SSD-12 ELECTRIC SYSTEM
- D. CHECK FOR PULDDOWN
- E. CHECK FOR DECHOKE (VISUAL)
- F. CHECK CAM CLEARANCE
- G. CHECK CHOKE PLATE ALIGNMENT
- H. CHECK CHOKE CAP INDEX SETTING
- I. CHECK FOR PROPER ASSEMBLY
- J. CHECK FOR DAMAGED PARTS
- K. CHECK FOR CONTAMINATION

24. CHECK HOT IDLE COMPENSATOR

- A. CHECK FOR DAMAGED PARTS
- B. CHECK FOR AIR LEAK
- C. CHECK PROPER TEMPERATURE CALIBRATION (NOT 4350)
- D. CHECK FOR CONTAMINATION
- E. CHECK FOR PROPER ASSEMBLY
- F. CHECK FOR RESTRICTION
- G. CHECK TO MAKE SURE THE BI-METALLIC STRIP IS COOL AND THAT THE COMPENSATOR PLUG IS SEATED BEFORE ATTEMPTING TO MAKE CARBURETOR IDLE ADJUSTMENT (4350 ONLY).

25. CHECK SPARK PORT, EGR PORT, AND/OR VENTURI PORT

- A. CHECK FOR RESTRICTION
- B. CHECK FOR CONTAMINATION
- C. CHECK FOR PROPER ASSEMBLY
- D. CHECK FOR DAMAGED PARTS
- E. CHECK FOR AIR LEAKAGE

26. CHECK EXTERNAL GASKETS AND GASKET SURFACES

- A. CHECK FOR AIR LEAKS
- B. CHECK FOR FUEL LEAKS
- C. CHECK FOR PROPER ASSEMBLY
- D. CHECK FOR DAMAGED PARTS

27. CHECK INTERNAL GASKETS AND GASKET SURFACES

- A. CHECK FOR AIR LEAKS
- B. CHECK FOR FUEL LEAKS
- C. CHECK FOR PROPER ASSEMBLY
- D. CHECK FOR DAMAGED PARTS
- E. CHECK FOR CONTAMINATION

28. CHECK DASHPOT AND BRACKET

- A. CHECK FOR PROPER ADJUSTMENT
- B. CHECK FOR PROPER ASSEMBLY
- C. CHECK FOR DAMAGED PARTS
- D. CHECK FOR CONTAMINATION

29. CHECK THROTTLE POSITIONER

- A. CHECK FOR PROPER ADJUSTMENT
- B. CHECK FOR PROPER ASSEMBLY
- C. CHECK FOR DAMAGED PARTS
- D. CHECK FOR RESTRICTION
- E. CHECK FOR CONTAMINATION
- F. CHECK PER SSD-19

CA4373-2C4

EMISSION CONTROL SYSTEM DIAGNOSIS AND SERVICE PROCEDURES

SSD-1: EGR SYSTEM DIAGNOSTICS**I. CHECK EGR SYSTEM FUNCTION**

1. Connect a tachometer to the engine at normal operating temperature.
2. Place the transmission selector in Neutral or Park and slowly increase the engine speed to 2300 RPM.
3. Remove and plug the vacuum line at the EGR valve fitting.
4. The engine speed should increase at least 50 RPM. If the engine speed does not increase by at least 50 RPM, the EGR System is functioning improperly.
5. If the EGR System is functioning improperly, or if engine has excessive roughness, perform appropriate diagnosis as described under Sections II through VII.

II. Poppet or Internal Tapered Stem Valves (9D475)

- A. With the engine off, remove the EGR vacuum hose from the EGR valve and plug. Connect a calibrated vacuum source with increments of 1.0 in. Hg and minimum capacity of 10 in. Hg to the EGR valve.
 - B.1. Gradually apply an 8 in. Hg. vacuum to the EGR valve and observe the movement of the EGR valve stem. The stem should move. If the stem does not move, replace the EGR valve.
- 2. Apply 8 in. Hg. vacuum to the EGR valve and trap. Vacuum should remain within 1 in. Hg. for a minimum of 30 seconds. Replace the EGR valve if out of specification.

C.1. With the engine at idle, apply vacuum to the EGR valve of at least 8 in. Hg. The valve is OK if the stem moves and the engine roughens. RPM should decrease and/or stop completely. If the idle quality doesn't change, there is no change in EGR flow and if the specifications of Step A and B have been met, something is plugging the EGR system. Perform the cleaning procedure to determine the problem (per Section V).

2. After the valve and EGR passages have been cleaned or replaced as necessary, install EGR valve, connect vacuum hoses, etc., and restart the engine.

3. Perform Step C.1. again to confirm EGR flow.

D. **Leakage Check:** If the EGR valve operates properly per Steps A and B above, but engine does not operate properly and has excessive idle roughness (or stalls), use the following procedure to check for any excessive EGR leakage:

1. Remove and cap the EGR valve vacuum hose. Start the engine. If engine idle quality has improved noticeably, double check the vacuum hose routing because valve may have a vacuum supply at idle.

2. If engine idle quality does not improve, remove the EGR valve. Block the EGR passages with a plate or slave EGR valve. Start the engine. If the idle quality is still bad, the problem is elsewhere. If the idle quality improves noticeably, the EGR has excessive leakage. Replace the EGR valve.

III. To Check the Carburetor EGR Port, Perform the Following Steps

A. Attach a vacuum gauge directly to the EGR Port on the carburetor.

B. With the engine running, open the carburetor throttle quickly and momentarily to at least the 1/2 open position. NOTE: Avoid over-speeding.

C. If the gauge rises and falls as the throttle is opened and closed, the EGR port is open and OK. If no vacuum is evident, the EGR port in the carburetor is plugged or restricted and should be cleaned.

IV. EGR TVS-PVS Functional Check

A. Perform a TVS functional check, SSD-9.

B. Perform a PVS functional check, SSD-3.

V. Procedure for Cleaning and Conditions for Replacement of the Poppet and Internal Tapered Stem EGR Valve (9D475)

A. EGR Valve Removal

1. Remove the EGR valve for cleaning.

CAUTION: Do not strike or pry on the valve diaphragm housing or supports, as this may damage the valve operating mechanism and/or change the valve calibration.

2. For all 9D475 valves, remove gasket, scrape gasket material from mounting flange and sand lightly. Clean the EGR valve in accordance with Steps 3 or 4 below if excessive carbon and/or lead deposits are observed. NOTE: These cleaning procedures are primarily for leaded

fuel applications but may be used for unleaded fuel applications, if necessary.

3. Preferred Cleaning Procedure (where facilities for blast cleaning metal parts are available):

a. Shield or block off underside of valve to protect diaphragm from inadvertent impingement from operation described in Steps B, C and D below. Use cardboard, a thin metal sheet, tape or similar material. Cap vacuum nipple.

b. With the valve in the closed position, direct grit blast stream through exit port. Open the valve with application of an 8 in. Hg. vacuum on the nipple. Direct grit blast stream through exit port. Allow abrasive to fall through and shake free from valve.

c. With the valve in a closed position, direct blaster stream through entrance ports. Open the valve with application of 8 in. Hg vacuum and direct stream through the entrance port. Allow the abrasive to fall through and shake free from valve.

d. Clean base surfaces with blaster to achieve satin finish. Caution: Do not direct abrasive stream against the diaphragm.

e. Remove debris, dust, oxide, etc. with shop air with the diaphragm retracted to open valve position.

f. Remove shield from diaphragm.

4. Alternate Cleaning Procedure:

a. Hold the valve assembly upright. Tap the base of the valve using a rubber or plastic hammer. Empty loose particles from the valve seat and chamber.

b. Open the valve by applying an 8" vacuum on the nipple and clean the valve seat and pintle with a wire brush.

c. Remove deposits from valve outlet, using a screwdriver, wire wheel or wire brush.

NOTE: DO NOT USE SOLVENTS FOR CLEANING.

B. Check of EGR Valve Function When Off the Engine

After cleaning the valve, hook an external vacuum source to the EGR valve and apply vacuum steadily up to 8 in. Hg. The valve stem must move smoothly without apparent sticking, binding or chattering action. The valve should not be noisy or exhibit excessive noise due to the above operation. If erratic motion or noise, as described above, is detected, replace the valve. The valve stem may cease to move above 7 in. Hg. or applied vacuum—this is not cause for replacement.

C. EGR Supply Tube and Spacers

1. Remove the carburetor and spacer except on engines where the valve is not mounted on the spacer.

2. Clean the supply tube with a small power driven rotary type wire brush or blast cleaning equipment.

3. Clean the exhaust gas passages/cavities in the spacer using a wire brush and/or scraper. The machined holes in the spacer can be cleaned by using a round wire brush. Hard encrusted material should be probed loose first, then brushed out.

D. Exhaust Gas Channels

1. Clean the exhaust gas channel in the intake manifold using a carbon scraper. Clean the exhaust gas entry port in the intake manifold by hand passing a drill bit thru the hole to auger out the deposits. Do not use a wire brush.

CAUTION: The manifold riser bore(s) should be plugged during the above action to prevent any residue from entering the induction system.

2. The 200 and 250 CID EGR valve is mounted on the side of the cylinder head below the carburetor pad. After removal of the EGR valve inspect the passages. If deposits are present in the exhaust passage (left hand side), remove with a wire brush or a drill bit. The re-entry passage (right hand side), may be cleaned with a drill bit, hand operated. Remove all foreign particles prior to re-assembly.

CAUTION: Do not allow pieces to get into the right hand side. An electric drill should not be used to remove deposits.

E. EGR Floor Entry Intake Manifold Maintenance

1. Remove the carburetor and the EGR valve.
2. Use scraper, dull drill or other means to clean the EGR passages, both at the EGR valve and below the carburetor in the floor.

CAUTION: The manifold riser bore(s) should be plugged during the above action to prevent any residue from entering the induction system. Remove all foreign particles prior to re-assembly.

3. Do not use a wire brush.

- F. Reinstall the valve and related components on the engine using new gaskets.

VI. Backpressure EGR Diagnostic procedure (Remote EGR Valve and Transducer 9F452).

- A. Remove the air cleaner assembly from the carburetor, if required to observe the EGR valve and backpressure transducer. Place the air cleaner in such a position so that the vacuum hoses are not disconnected from the air cleaner TVS switch.
- B. Inspect the EGR system vacuum routing for proper connections. (Refer to the Vehicle Emission Control Information Decal). Check vacuum supply to valve, per SSD-1, Section III.
- C. Inspect the remote backpressure transducer assembly for obvious external defects, such as loose or broken support brackets, loose or broken vacuum nipples, exhaust blow-outs at the base to the carburetor spacer (or EGR valve) gasket and failed pressure tube to diaphragm housing

joint. Replace the transducer if obviously defective, or replace the spacer gasket if defective.

D. EGR System Function Check

1. Connect a tachometer.
2. Warm up the engine to normal operating temperature.
3. Slowly open and close the throttle to approximately 2500 RPM, the EGR valve stem must move upward, appear to oscillate and move downward to the closed position when engine returns to idle. **CAUTION: Do not exceed 1/2 throttle or 2500 RPM.**

If the valve stem moves or operates properly and the engine shows very little roughness and variation in speed during this test sequence—the EGR system is functioning properly. Discontinue the Diagnostic Procedure and return to the Diagnostic Routine.

- E. If the EGR valve stem does not move and/or oscillate properly, perform the following checks:

1. **Vacuum Source:** Connect a vacuum gauge to the TVS or PVS nipple. Slowly open and close the throttle and observe the vacuum signal on the gauge:

- a. If the vacuum signal is less than 4.0 in. Hg., check the EGR PVS or air cleaner TVS switch. Also check the vacuum source (Section III).
- b. If the vacuum signal is 4.0 in. Hg. or greater, the problem is associated with the backpressure transducer or the EGR valve. Check the EGR valve and backpressure transducer as described in Step 2 and 3 below.

2. **EGR Valve:** Diagnose EGR valve function in accordance with Section II.

3. **EGR Transducer:** Warm up engine to normal operating temperature. Disconnect the EGR valve hose at the EGR valve and install a vacuum gauge. With transmission in neutral (or Park), slowly open and close the throttle to approximately 2500 RPM. Observe the vacuum gauge reading:

- a. If vacuum reading goes up (to approximately 4-10 in. Hg) and reduces to zero (at idle), the EGR transducer is functioning properly.
- b. If vacuum reading stays at zero (does not increase with throttle opening), replace the EGR transducer.

VII. Backpressure EGR Valve Procedure (Integral Type B/P EGR Valve—9D448)

- A. Remove the air cleaner assembly from the carburetor, if required, to observe the EGR valve. Place the air cleaner in such a position so that the vacuum hoses are not disconnected from the air cleaner TVS switch.
- B. Inspect the EGR system vacuum routing for proper connections. (Refer to the Vehicle Emission Control Information Decal). Check vacuum supply to valve, per SSD-1, Section III.

- C. Inspect the integral EGR valve assembly for obvious external defects, such as loose or broken support brackets, loose or broken diaphragm vacuum nipple, and exhaust blow-outs at the base to upper cover gasket or base to the carburetor spacer gasket. Replace the valve if obviously defective, or replace the spacer gasket if defective.

D. EGR Valve Function Check

1. With engine off, use the following method to functionally check the transducer of the integral Backpressure EGR Valve.
 - a. Remove EGR valve vacuum hose.
 - b. Attach an external 6" Hg or greater vacuum source to the EGR valve nipple (a hand vacuum pump may be used).
 - c. The transducer should leak vacuum and valve should not open. If the valve opens the transducer has failed in the closed position. Replace the EGR valve.
2. Start the engine and warm to normal operating temperature.
- 3 a. With the transmission in Neutral (or Park), slowly open and close the throttle. Observe the EGR valve stem or underside of the diaphragm to which the valve stem is attached. The stem and diaphragm must move upward, appear to oscillate, and move downward to closed position when the engine returns to idle.
 - b. If unable to detect if valve stem moves and oscillates (Step D.,3.,a.), open the throttle to 2000 - 2500 RPM and hold at a steady speed. Then remove and pinch off EGR vacuum hose. With vacuum hose disconnected, engine speed should increase significantly (at least 50 RPM increase).

CAUTION: DO NOT exceed 1/2 throttle or 2500 RPM.

- c. If valve operates as described above, the valve transducer is functioning properly. If the valve does not operate as described above the transducer is malfunctioning, replace the EGR valve.
4. **Leakage Check:** If engine does not operate properly and has excessive idle roughness or stalls, use the following procedure to check for any excessive EGR leakage:
 - a. Remove and cap the EGR valve vacuum hose. Start the engine. If engine idle quality has improved noticeably, double check the vacuum hose routing, because valve may have a vacuum supply at idle.
 - b. If engine idle quality does not improve, remove the EGR valve. Block the EGR passages with a plate or slave EGR valve. Start the engine. If the idle quality is still bad, the problem is elsewhere. Reinstall the EGR valve. If the idle quality improves noticeably, the EGR valve has excessive leakage. Replace the EGR valve.

VIII. EGR Vacuum Load Control Valve Diagnostic Procedure.

- A. Remove air cleaner assembly from carburetor to

observe the EGR valve. Place the air cleaner assembly in such a position so that vacuum hoses are not disconnected from the air cleaner TVS switch.

- B. Check the EGR system vacuum hose routing for proper connection (per Emission Decal or Vehicle Specification Sheet).
- C. Warm up engine to normal operating temperature and connect tachometer.
- D. While slowly opening and closing the throttle, the EGR valve stem must move upward and/or oscillate and move downward to the closed position when the throttle is released to the idle position.

CAUTION: Do not exceed 1/2 throttle or 3000 RPM when opening or closing throttle.

If the EGR valve stem moves and/or oscillates properly, the EGR system is functioning satisfactorily. Discontinue the diagnostic procedure. Replace air cleaner.

- E. If the EGR valve stem does not move and/or oscillate properly, disconnect the vacuum supply hose between the EGR vacuum load control valve and the TVS, at the vacuum load control valve, and connect a vacuum gauge to the hose. Raise the engine speed to 1200 - 1500 RPM in Neutral and observe the vacuum signal:

1. If vacuum signal is less than 4.0 in. Hg., proceed as follows:
 - a. Perform EGR PVS Procedure SSD-3.
 - b. Perform Air Cleaner TVS Switch Procedure SSD-9.
 - c. Perform either Carburetor EGR port Procedure SSD-1, Section III, or Carburetor Spark Port, depending on the vacuum source to the load control valve.
2. If the vacuum signal is 4.0 in. Hg. or greater, remove the gauge, reinstall the vacuum hose on the EGR vacuum load control valve and proceed to Step F.
- F. Remove the vacuum hose between the EGR vacuum load control valve and the EGR backpressure transducer at the vacuum load control valve and connect a vacuum gauge to the vacuum load control valve port.
 1. Remove the hose from the venturi port on the carburetor to the vacuum load control valve at the valve.
 2. Raise the engine idle speed to 1200 - 1500 RPM in Neutral and observe the vacuum signal.
 - a. If the vacuum signal is less than 4.0 in. Hg, replace the EGR vacuum load control valve.
 - b. If the vacuum signal is 4.0 in. Hg. or greater, apply one of the following vacuum levels, from an external source, to the venturi port of the load control valve, and observe the first gauge signal:

Decal Color of EGR Vacuum Load Control	Vacuum Level (in. Hg) Applied to Venturi Port
Blue	3.0
Red	4.5

If the gauge signal does not drop less than 2.0 in. Hg, replace the load control valve. If the gauge signal drops to less than 2.0 in. Hg. and does not return to greater than 4.0 in.

Hg. when the external source vacuum is removed from the venturi port, replace the load control valve.

SSD-2: VACUUM DELAY VALVE

Equipment Required

- Vacuum Gauge - 0 - 30" Hg. vacuum gauge with 0.2" O.D. vacuum hose nipple adaptor and 24" of 5/32" I.D. distributor vacuum hose or equivalent.
- Stop watch or wrist watch with a sweep second hand.
- External vacuum source capable of maintaining a constant vacuum (10" Hg. minimum).

Procedure

I. Vacuum Delay Valve (12A189):

A. Instructions:

NOTE: Exercise care in order to prevent oil or dirt from getting into the valve.

- Set the external vacuum source to 10" Hg.
- Connect the black side of delay valve to the vacuum source.
- Connect the 24" section of vacuum hose to the gauge and to the colored side of the delay valve.
- Apply vacuum and observe the time, in seconds, for the gauge to read from 0 to 8" Hg. with a constant 10" Hg. vacuum source.

B. Specifications:

The minimum and maximum time for the valve to reach 8" Hg. should be as follows:

Color	I.D. No.	Time in Seconds	
		Min.	Max.
Black/Gray	1	0.6	1.6
Black/Brown	2	1.0	3.0
Black/White	5	2.7	9.3
Black/Yellow	10	4.5	13.2
Black/Blue	15	6.8	18.8
Black/Green	20	8.0	26.0
Black/Orange	30	11.6	38.0
Black/Red	40	14.0	47.2

CV1382-1D

II. Retard Delay Valve (9E897):

A. Instructions:

NOTE: Exercise care in order to prevent oil or dirt from getting into the valve.

- Set external vacuum source to 10" Hg.
- Connect the colored side of the delay valve to the vacuum source.
NOTE: A. 20" O.D. to a .27" O.D. adaptor is required to connect the colored side of the valve to the vacuum source.
- Connect the 24" section of vacuum hose to the gauge and to the white side of the delay valve.
- Apply vacuum and observe the time, in seconds, for the gauge to read from 0 to 8" Hg. with a constant 10" Hg. vacuum source.

B. Specifications:

The minimum and maximum time for the valve to read 8" Hg. should be as follows:

Color	I.D. No.	Time in Seconds	
		Min.	Max.
White/Red	40	14.0	47.2
White/Blue	20	8.0	26.0

CA1384-1E

C. Corrections:

Replace the delay valve if the above test showed it to be defective. Otherwise, re-install the delay valve to its original position.

III. Two-Way Delay Valve (12A245):

A. Instructions:

NOTE: Exercise care in order to prevent oil or dirt from getting into the valve.

- Set external vacuum source to 10" Hg.
- Connect one side of the delay valve to the vacuum source.
- Connect the 24" section of vacuum hose to the gauge and to the other side of the delay valve.
- Apply vacuum and observe the time, in seconds, for the gauge to read from 0 to 8" Hg. with a constant 10" Hg. vacuum source.

B. Specifications:

The minimum and maximum time for the valve to read 8" Hg. should be as follows:

Color	I.D. No.	Time in Seconds	
		Minimum	Maximum
Brown	2	1.0	3.0
White	5	2.7	9.3
Yellow	10	4.5	13.2
Green	20	8.0	26.0
Red	40	14.0	47.2

CA5080-1A

C. Corrections:

Replace the delay valve if the above test showed it to be defective. Otherwise, re-install the delay valve to its original position.

IV. Vacuum Vent Delay Valve (12A226):

A. Instructions:

NOTE: Exercise care in order to prevent oil or dirt from getting into the valve.

- Set external vacuum source to 10" Hg.
- Connect the "vac" side (side with I.D. number) of the vacuum vent valve to the vacuum source.
- Connect the 24" section of vacuum hose to the gauge and to the other side of the delay valve.
- Apply vacuum and observe the time, in seconds, for the gauge to read from 0 to 8" Hg. with a constant 10" Hg. vacuum source.

B. Specifications:

The minimum and maximum time for the valve to read 8" Hg. should be as follows:

I.D. No.	Time in Seconds	
	Minimum	Maximum
20	16	36.8
40	28	67.6
5	7	13.7

CA5081-1A

C. Corrections:

Replace the delay valve if the above test showed it to be defective. Otherwise, re-install the delay valve to its original position.

SSD-3: PVS FUNCTIONAL CHECK

- I. For each type of PVS valve, start the engine and warm it up until the engine coolant temperature is above the calibrated temperature of the PVS valve as indicated below according to color.

Color	Temperature
Pink Top or Natural Top	Above 90°
Black Top	Above 100°
Plain Dichromate or Blue Top	Above 133°
Yellow Top or Gray Top	Above 155°

CA5082-1A

II. PVS with Two Connectors.

- A. Disconnect both vacuum hoses at the PVS valve. Connect the vacuum gauge to the top connector on the PVS. Connect manifold vacuum or auxiliary vacuum source of at least 10 in. Hg to other connector.
- B. Start the engine and warm it up until engine coolant temperature is above the calibration temperature of the EGR PVS as previously indicated.
 1. If no reading is noted on the vacuum gauge, PVS has failed and should be replaced.
 2. If vacuum is noted, PVS is okay.

III. PVS with Three Connectors.

- A. Disconnect the EGR vacuum hose from the PVS valve and connect manifold vacuum or auxiliary vacuum source of at least 10 in. Hg to the lowest port.
- B. Disconnect the distributor vacuum hose at port "D" (center port) of the PVS valve and connect a vacuum gauge to the center port.
 1. If no reading is noted on the vacuum gauge, PVS has failed and should be replaced.
 2. If vacuum is noted, PVS is okay.

IV. PVS with Four Connectors.

- A. Disconnect the vacuum hoses at the PVS valve. Connect a vacuum gauge to port "D" (top port) and a vacuum supply to port "M" (second port).
- B. Start the engine and warm until coolant temperature is above the calibration temperature of the PVS.
 1. If no reading is noted on the vacuum gauge, PVS has failed and should be replaced.
 2. If vacuum is noted, go to the next step.

- C. Connect a vacuum gauge to port "E" (third port) and a vacuum supply to port "S" (bottom port) of at least 10 in. Hg vacuum.
- D. Start the engine and make sure it is warmed past the calibration temperature of the PVS valve.
 1. If no reading is noted on the vacuum gauge, PVS has failed and should be replaced.
 2. If vacuum is noted, PVS is okay.

V. Cooling PVS**A. Functional check.**

Disconnect the vacuum line leading from the distributor at port "D" (center port) of the PVS valve. Connect a suitable vacuum gauge and vacuum hose to port "D" of the PVS valve in line with the port. Run the engine at normal idle. If the vacuum reading is 2 in. Hg or less, the cooling PVS is okay. If the vacuum reading is greater than 2 in. Hg, remove the top vacuum line (the line that goes to the carburetor) at the cooling PVS and plug. If the vacuum reading is still greater than 2 in. Hg, the cooling PVS is leading, replace it.

B. Cooling PVS Operation Check

1. Check all vacuum hose routings and connections. If incorrect or loose, re-route hoses correctly. Replace any broken, split or cracked hose and secure loose connections.
2. Disconnect the vacuum line leading from the distributor at port "D" (center port) of the PVS valve. Connect a suitable vacuum gauge and vacuum hose to port "D" of the PVS valve in line with the port. Leave other lines connected to the valve.
3. Remove the backing from the Tempilabel exposing the adhesive surface and press firmly onto the thermostat housing or intake manifold surface in close proximity to the cooling PVS valve where it can easily be seen. Use the Tempilabel new series temperature monitor part rated at 235°F. Mounting surface should be cleaned of all dirt, oil, and foreign matter using a suitable solvent and wiping dry with a clean dry cloth.

NOTE: A Tempilabel 240° may be used if the 235° is not readily available.
4. Restrict the incoming air to the radiator by placing a piece of cardboard in front of the radiator.
5. Idle the vehicle to heat up the cooling system. Monitor the vacuum gauge attached to the PVS

cooling valve for an increase in vacuum before the silver colored Tempilable turns black (color change indicates 235° F. temperature has been reached). If the vacuum fails to increase before

the indicator changes color, replace the PVS valve as being defective, if the vacuum gauge shows a definite increase in vacuum before the color change, the PVS valve is considered good.

SSD-4—THERMACTOR SYSTEM, NON-CATALYTIC

The thermactor non-catalyst system consists of the following major components:

- Belt-driven air pump
- Air by-pass valve
- Check valve(s)
- Internal or external air manifold(s)
- Air supply tubes
- Crossover tubes to connect RH and LH air manifolds (internal system only)
- Idle dump delay valve

Special tools required:

- Air pump supply tester (Rotunda Tool No. T75L-9486-A or equivalent)
- Check valve tester (Rotunda Tool No. T75L-9487-A or equivalent)
- Adaptor (hose and elbow) to connect to side mounted or cover mounted by-pass valves
- Bell tension gauge (Rotunda Tool No. T63L-8620-A or equivalent)
- Thermactor pump belt tension adjuster (Rotunda Tool No. T75L-9480-A or equivalent)

Thermactor Components Tests and Adjustments

A. Air pump supply test

1. Remove air cleaner.
2. Inspect all hoses and hose connections in the system for any abnormal conditions and correct and/or repair and/or replace as necessary.
3. Check the air pump belt tension and adjust to specifications as listed in the truck service specifications book. (See part "B" of this procedure).
4. With the transmission in neutral or park and the parking brake on, warm the engine to normal operating temperature. If a noise complaint can be isolated in the air pump, see part "E" of this procedure.
5. Stop the engine and disconnect the air supply hose(s) from the air pump to the air by-pass valve from the pump.
6. Install the thermactor pump test gauge Rotunda Tool No. T57L-9486-A or equivalent in the end of the hose disconnected from the by-pass valve. Clamp the hose securely to the air supply tester to prevent it from blowing out.

NOTE: For side or cover mounted by-pass valves, install an elbow and hose adapter and then insert the Rotunda Tool No. T57L-9486-A or equivalent.

CAUTION: Position the air pump supply tester so that the air blast emitted will be harmlessly dissipated.

7. Connect a tachometer to the engine and start the engine.

8. Slowly increase engine speed to 1000 rpm and observe the pressure produced at the test gauge. The air pump pressure must be 2.25 (2 1/4) psi minimum.

If Rotunda tool is not available, increase engine speed to 1500 rpm, place hand over the open hose. Air flow should be heard and felt.

9. If air flow does not comply with minimum requirements listed in Step 8, install a new air pump and repeat Step 8.
10. Turn off the engine. Remove all test equipment and reconnect the air supply hose to the air by-pass valve and tighten the hose clamp. Tighten the air cleaner nut to specification if the cleaner was removed.

B. Thermactor Air Pump Drive Belt Adjustment

1. Install the belt tension gauge Rotunda Tool T63L-8620-A or equivalent on the drive belt and check the tension following the instructions of the tool manufacturer. Compare the belt tension to the specified belt tension and adjust as necessary. (Refer to the truck service specifications book).
2. If adjustment is necessary, loosen the air pump mounting an adjusting arm bolts. Move the air pump toward or away from the engine until the correct tension is obtained. Use Rotunda Tool T75L-9480-A or equivalent to hold belt tension while tightening the mounting bolts. Remove the gauge. Tighten the air pump adjusting arm and mounting bolts. Install the tension gauge and check the belt tension.

CAUTION: Do not use a pry bar to move air pump.

3. Check all air pump pulleys and mounting bolts and tighten to specifications. (Refer to the truck service specifications book).

CAUTION: Any belt that has operated for a minimum of ten minutes is considered a used belt; and when adjusted, it must be adjusted to the tension shown in the specifications for used belts. (Refer to the truck service specifications book).

C. Air By-Pass Valve and Control Valve

1. Air By-Pass Valve Functional Tests (Timed By-Pass Valve).

Determine if the air by-pass valve (Fig. 1) is functioning properly by performing the following operation:

- a. If necessary, warm the engine to normal operating temperature with the transmission in neutral or park and the parking brake on.
- b. Stop the engine and remove the air by-pass valve-to-air manifold check valve hose at the by-pass valve. For a "T" system, remove both hoses connecting the by-pass valve to the check valves. Install a tachometer on the engine.

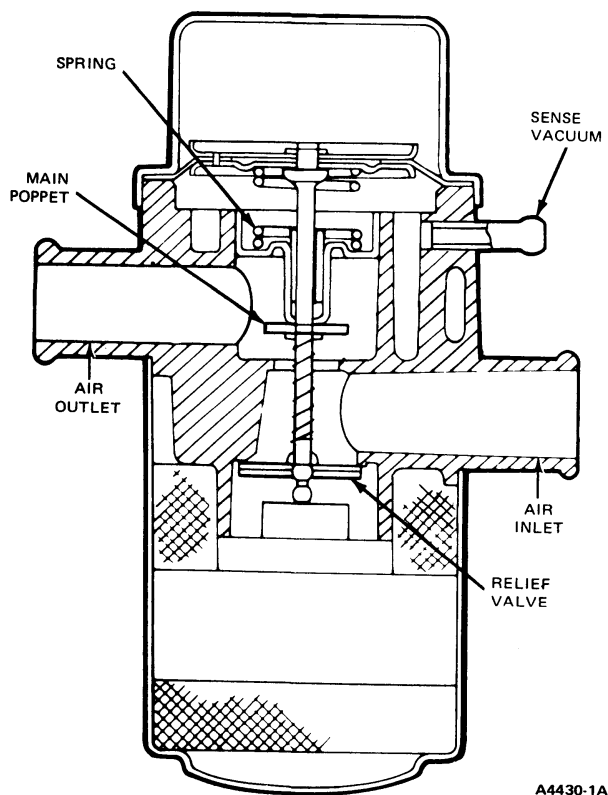


FIG. 1 Timed Air By-Pass Valve

- c. With the transmission in neutral or park and the parking brake on, start the engine. Accelerate the engine to 1500 rpm. Verify that air is flowing from the air by-pass valve hose connection(s) by placing hand over valve connection. Air flow should be felt and heard.
- d. With transmission in neutral or park and parking brake on, accelerate to 1500 rpm. With hand held over the by-pass valve connection for approximately 5 to 8 seconds, pinch off the vacuum hose to the by-pass valve to duplicate the air by-pass cycle. Release the pinched vacuum hose. Air flow thru the by-pass valve should be felt and heard to diminish or stop for a short period of time, then resume normal air flow. The length of time required to resume normal flow cannot be specified since the time interval is dependent on engine vacuum and length of time the vacuum line is pinched off. Air will be discharged thru the exhaust ports in the side of the valve silencer cover. If this complete cycle does not occur, the valve is damaged and it must be replaced.
- e. Perform the following test **ONLY** if the air pump supply tester is available:

Install the Thermactor Pump Test Gauge Rotunda Tool T75L-9486-A or equivalent to the air by-pass valve outlet using a short length of appropriate diameter hose. If the air by-pass valve has two outlets, plug the one without the tester. Increase the engine speed to 1000 rpm. Observe the pressure produced at the test gauge. The air pressure must be 2.25 (2 1/4)

psi minimum. If the air pressure is not within specifications, replace the valve.

- f. Turn off the engine, remove all test equipment and connect the air supply hose(s) to the air by-pass valve(s), and tighten all clamps.
2. Vacuum delay valve check (Only required on vehicles equipped with a delay valve in the by-pass valve line).

Determine if the air by-pass valve control is functioning properly by performing the following operation.

Equipment required:

- Vacuum gauge—2 in. dia., 0-30 in. Hg vacuum gauge with 0.20 in. OD vacuum hose nipple adaptor and 24 in. of 5/32 in. ID distributor vacuum hose or equivalent.
- Stop watch or wrist watch with a sweep second hand.
- External vacuum source capable of maintaining a constant vacuum (10 in. Hg minimum).

Delay valve functional test

- a. Remove the air cleaner, if necessary.
- b. Remove the delay valve.
- c. Set external vacuum source to 10 in. Hg.
- d. Connect colored side of delay valve to vacuum source.

Note: 0.20 in. to 0.27 in. OD adaptor may be required to connect colored side of valve to vacuum source.

- e. Connect the 24 in. section of vacuum hose to gauge and to white side of delay valve.
- f. Apply vacuum and observe time in seconds for gauge to rise from 0 to 8 in. Hg with a constant 10 in. Hg vacuum source.

The minimum and maximum time for the delay valve to reach 8 in. Hg should be as follows:

Color	I.D. No.	Time in Seconds	
		Min.	Max.
White/Red	40	14.0	47.2
White/Green	20	8.0	26.0
White/Blue	20	8.0	26.0

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Note: When checking the delay valve, care must be exercised to prevent oil or dirt from getting into the valve as this will impair its function.

- g. Replace the delay valve if the above test showed it to be damaged. Otherwise, reinstall delay valve to its original position.
- h. Reinstall air cleaner and tighten air cleaner nut to specification.

D. Check Valve Test

1. With the engine stopped, inspect the hose(s) from the check valve to the by-pass valve for any leaks due to cracks, splits, holes, etc. Replace if required.
2. Inspect the hose clamp(s) at the check valve for being properly positioned and tightened. Correct, position, tighten or replace as required.

3. Disconnect the thermactor hose(s) from check valve to the by-pass valve at the by-pass valve end.
4. Connect the Thermactor Check Valve Tester, Rotunda Tool T75L-9487-A or equivalent, to the open end of the check valve hose. Position the hose clamp and tighten to specification. Refer to the truck service specifications book.
5. Squeeze the rubber bulb on the tester to force as much air from the bulb as possible. Quickly release the bulb and start timing. The bulb should remain collapsed and not return to its original free shape for at least 15 seconds.
 - a. If the test bulb does not return to its original free shape for 15 seconds, the check valve and hose are good. Remove the check valve tester from the end of the hose and reinstall the hose on the by-pass valve. Position and tighten the hose clamp to specification. Refer to the truck service specifications book.
 - b. If the test bulb returns to its original free shape in 15 seconds or less, both hose and check valve are questionable.
 - c. Remove the test bulb from the end of the hose. Remove the hose from the check valve. Install a 6 to 18 inch length of appropriate diameter hose to the check valve and test bulb. Position a hose clamp at each end of the hose and tighten to specification. Repeat Step 5 above.
- (1) If the test bulb does not return to its original free shape for 15 seconds it indicates the check valve is good and the original by-pass valve to check valve hose is damaged. Remove the test hose from the check valve and test bulb. Install a new hose of the proper part number, to the check valve and test bulb.

Position a hose clamp at each end of the hose and tighten to specification. Repeat Step 5 to be sure the new hose does not leak. After the test, remove the hose clamp and test bulb. Install the hose on the by-pass valve nipple. Position the hose clamp and tighten to specification.

- (2) If the test bulb returns to its original free shape in 15 seconds or less, the check valve is damaged and is to be replaced.
- (3) Test the new check valve for leaks before installing on the engine. Connect a 6 to 18 inch length of appropriate diameter hose to the new check valve and test bulb. Position a hose clamp at each end of the hose. Repeat Step 5 above.
- (4) Remove the hose from the check valve. Install the new check valve on the engine and tighten to specification. Visually inspect the original hose for any surface condition that would cause a problem in the near future. Replace with a new hose if required. Install the hose on the check valve and by-pass valve nipples. Route the hose as required. Position a hose clamp at each end of the hose and tighten to specification.

E. Thermactor System Noise Test

NOTE: The thermactor system is not completely noiseless. Under normal conditions, noise rises in pitch as engine speed increases. To determine if excessive noise is caused by the air injection system, disconnect the drive belt and operate the engine. If the noise disappears, proceed with the following diagnosis.

CONDITION	POSSIBLE CAUSE	CORRECTION
Excessive belt noise.	- Loose belt. - Seized pump. - Loose pulley. - Loose or broken mounting brackets or bolts.	- Tighten to specification* using tool #T75L-9480-A to hold belt tension and Belt Tension Gauge #T63L-8620-A. CAUTION: Do not use a pry bar to move the air pump. - Replace pump. - Replace pulley and/or pump if damaged. Tighten bolts to specification (130-180 in-lbs). - Replace parts as required and torque bolts to specification.*
Excessive pump noise (chirps, squeaks and ticks).	Insufficient break-in or worn or damaged pump.	Check the thermactor system for worn or damaged parts and make any necessary corrections. If less than 500 miles in service, allow for a 500 mile break-in period. Replace the pump if the noise continues after a 500 mile break-in period.
Excessive mechanical clicking noise.	- Over-torqued mounting bolt. - Excessive flash on the air pump adjusting arm boss. - Distorted adjusting arm. - Adjusting arm bolt too long (bottom of the bolt boss is pushed in). - Loose by-pass valve.	- Tighten to 25 ft-lbs. - Remove flash from the boss. - Replace adjusting arm. - Replace pump using a proper length bolt. - Tighten bolts to 130-180 in-lbs. - Check for missing gasket. Install new gasket. - Check for missing mounting bolts. Install new bolts.
Excessive thermactor system noise (putt-putt, whirring or hissing).	- Leak in hose. - Loose, pinched or kinked hose. - Hose touching other engine parts. - By-pass valve inoperative. - Check valve inoperative. - Pump mounting fasteners loose. - Restricted or bent pump outlet fitting. - Pump failure. - Loose by-pass valve.	- Locate source of leak using soap solution and replace worn or damaged hoses. - Reassemble, straighten or replace hose and clamps as required. - Adjust hose to prevent contact with other engine parts. - Test by-pass valve and replace if found damaged. - Test check valve and replace if found damaged. - Tighten fasteners to specification. - Inspect fitting and remove any flash blocking the air passage way. Replace bent fittings. - Replace pump. - Torque bolts to 130-180 in-lbs. - Check for missing gasket. Install new gasket. - Check for missing bolts. Install new bolts.

*Refer to Truck Service Specifications Book.

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SSD-5: THERMACTOR SYSTEM CHECK

I. The Thermactor System consists of the following major components:

- Air supply pump
- Air by-pass valve
- Air control valve
- Check valve(s)
- Internal or external air manifold(s)
- Air supply tubes
- Crossover tube to connect R.H. to L.H. air manifolds (internal system only)
- Differential vacuum valve (Decel)
- Air cleaner temperature sensor
- Electric PVS (Ported vacuum switch) high temperature coolant lock-out
- Solenoid vacuum valve
- EGR vacuum load control valve (for EGR and thermactor)
- Vacuum delay valve (idle air dump)

- Thermactor idle vacuum valve
- Thermactor vacuum vent valve.

II. Air Pump Supply Test

- Remove the air cleaner.
- Inspect all hoses and hose connections in the system for any abnormal conditions and correct, repair and/or replace as necessary.
- Check the air pump belt tension and adjust to specification as listed in the truck specification book. (See Step III).
- With the transmission in Neutral or Park and the parking brake on, warm the engine to normal operating temperature.
- Stop the engine and disconnect the air supply hose(s) from the air by-pass valve.
 - If installation is a side or cover mounted by-pass valve, remove the by-pass valve from the pump.
- Insert the air pump supply tester (Rotunda Tool #T75L-9486-A or equivalent) in the end of the

hose disconnected from the by-pass valve and clamp the hose securely.

- For side or cover mounted by-pass valves, install an elbow and hose adaptor and then insert the Rotunda Tool T75L-9486-A or equivalent.

CAUTION: Position the thermactor pump pressure gauge so that the air blast emitted will be harmlessly dissipated.

- Connect a tachometer to the engine and start the engine.
- Slowly increase engine speed according to the following chart and observe the pressure produced at the gauge(s).

AIR SUPPLY PUMP OUTPUT CHART		
Flow (lbs-hr)	PSI @ 1000 RPM	PSI @ 2000 RPM
13	—	0.50
20	—	1.00
31	2.25	—

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- If the Rotunda tool is not available, increase the engine speed to 1500 RPM, place your hand over the open hose. The air flow should be heard and felt.
- If the air flow does not comply with minimum requirements listed in Steps H or I, install a new air pump and repeat Steps H or I.
- Turn off the engine. Remove all test equipment and restore hose connections and the air cleaner.

III. Thermactor Air Pump Drive Belt Adjustment

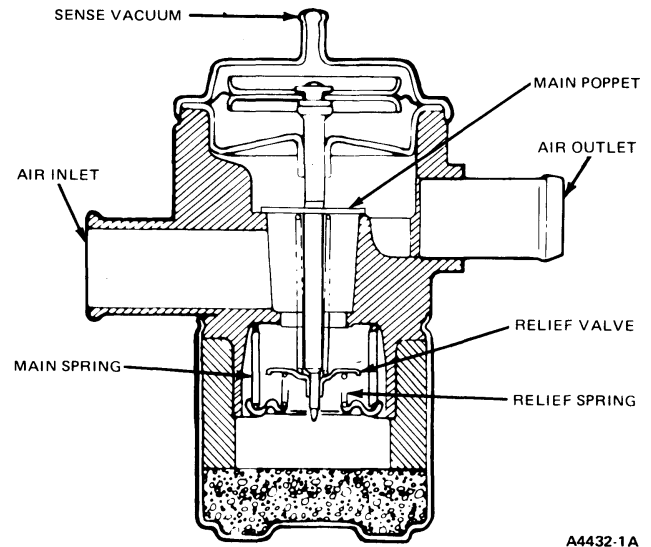
- Install the belt tension gauge (Rotunda Tool #T63L8620-A or equivalent) on the drive belt and check the tension. Compare the belt tension to the specified belt tension and adjust as necessary. (Refer to the respective Truck Series Service Specification Book).
 - If it is absolutely impossible to use a tension gauge, the following procedure may be substituted on "V" belts only.
 - Press firmly on the belt (approximately at the middle of the free span between pulleys).
 - Belt deflection should be as follows:
 - For all belts with a free span less than 12 inches, deflection should be between 1/8 inch and 1/4 inch.
 - For all belts with a free span greater than 12 inches, deflection should be between 1/8 inch and 3/8 inch.
 - If adjustment is necessary, loosen the air pump mounting and adjusting arm belts, move the air pump toward or away from the engine until the correct tension is obtained. Use air pump belt tensioning tool (Rotunda Tool #T75L-9480-A or equivalent) to hold belt tension while tightening the mounting bolts. Install the tension gauge and check the belt tension.
- CAUTION: Do not use a pry bar.**
- Check all air pump pulleys and mounting bolts and torque to specification. (Refer to the respective Truck Series Service Specifications Book).

IV. Thermactor Air Valve By-Pass Functional Tests

- NORMALLY CLOSED BY-PASS VALVES, (Figs. 2, 3 and 4.)

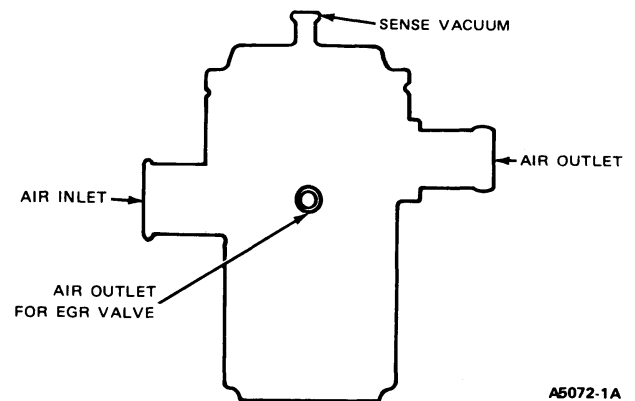
Determine if the air by-pass valve is functioning properly by performing the following operations.

- If necessary, warm the engine to normal operating temperature with the transmission in Neutral or Park and the parking brake on.
- Stop the engine and remove the air check valve hoses at the by-pass valve. For a "Tee" system, remove both hoses connecting the by-pass valve to the check valves. Install a tachometer on the engine.



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FIG. 2 Normally Closed Air By-Pass Valve



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FIG. 3 Normally Closed Air By-Pass Valve with EGR Air Pressure Tap

- With the transmission in Neutral or Park, and the parking brake on, start the engine. Accelerate the engine to 1500 RPM. Verify that air is flowing from the air by-pass valve hose connection(s) by placing your hand over the valve connection. Air flow should be heard and felt.
- Remove the vacuum hose from the by-pass valve and plug off the vacuum hose. With the engine at 1500 RPM and your hand held over the by-pass valve connection, there should be

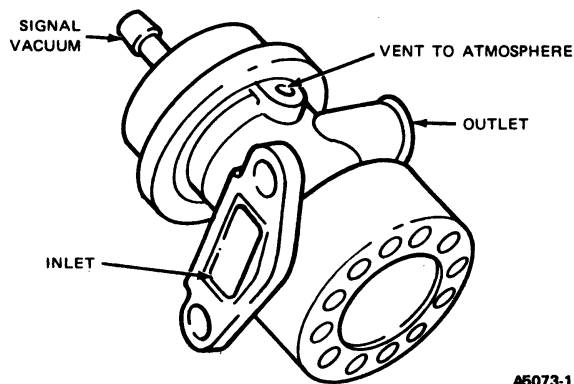


FIG. 4 Normally Closed Pump Mounted Air By-Pass Valve with EGR Air Pressure Tap

virtually no air flow felt or heard. Air flow will be discharged thru the exhaust vents in the end of the air by-pass valve silencer cover.

If air flow is felt or heard thru the by-pass valve connection, the valve is damaged and should be replaced.

5. Stop the engine. Remove the plug from the vacuum hose.
6. Reinstall the vacuum hose on the by-pass valve sense vacuum nipple.
7. If available, install the thermactor pump pressure gauge (Rotunda Tool #T75L-9486-A or equivalent) to the air by-pass valve outlet using a short length of appropriate diameter hose. If the air by-pass valve has two outlets, plug the one without the tester. If the air by-pass valve has a small pressure outlet, as pictured in (Fig. 4) install a pressure gauge on this port. Start the engine and increase engine speed. Observe the pressure produced at the test gauge(s). Refer to the chart in II. H.
8. Turn off the engine, remove all test equipment and restore hose connections.

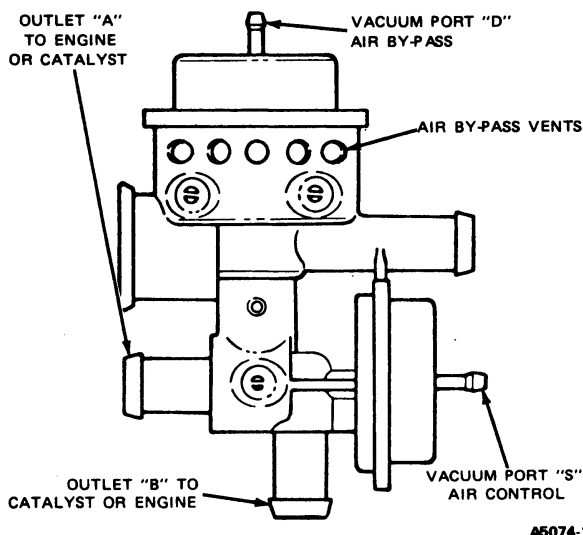


FIG. 5 Combination Air By-Pass and Air Control Valve

B. COMBINATION BY-PASS AND AIR CONTROL VALVES.

Determine if the combination By-pass and Air Control Valve (Fig. 5) is functioning properly by performing the following operations:

1. If necessary, warm the engine to normal operating temperature with the transmission in Neutral or Park and the parking brake "ON".
2. Stop the engine and remove the air hoses from the combination valve at outlets "A" and "B".
3. Disconnect and plug the Vacuum Hose from Vacuum port "D".
4. Install a tachometer on the engine.
5. With the transmission in Neutral or Park and the parking brake on, start the engine. Accelerate the engine to 1500 RPM. Verify that air is flowing from the air by-pass vents by placing your hand over the vents. Virtually no air flow should be heard or felt at outlets "A" and "B". If air flow is detected at outlet "A" or "B", the valve is damaged and should be replaced. Reconnect vacuum hose to port "D".
6. Disconnect and plug the vacuum hose from vacuum port "S". Verify that vacuum is present. With the engine at 1500 RPM and your hand held over outlet "A", there should be virtually no air flow felt or heard. Air flow will be discharged thru outlet "B". If air flow is felt or heard thru outlet "A", the valve is damaged and should be replaced.
7. Stop the engine and connect a hose from an external vacuum source and apply 8-10 in. Hg. vacuum to vacuum port "S".
8. With the transmission in Neutral or Park and the parking brake on, start the engine. Accelerate the engine to 1500 RPM. Air flow should be felt and heard at outlet "A". If air flow is not felt or heard at outlet "A", the valve is damaged and should be replaced. Check outlet "B". Virtually no air flow should be felt or heard at Outlet "B". If air flow is detected at outlet "B", the valve is damaged and should be replaced.
9. Stop the engine and remove the vacuum source from port "S".
10. If available, install the thermactor pump pressure gauge (Rotunda Tool #T75L-9486-A or equivalent) to outlet "B" using a short length of appropriate diameter hose. Start the engine and increase engine speed according to the chart in 2. H. and observe the test gauge(s).
11. If the air flow does not comply with the minimum requirements, verify Air Pump Supply (SSD-5 II).
12. If the Air Pump Supply is verified and the air flow through the valve does not comply, the valve is damaged and should be replaced.
13. Turn off the engine, remove all test equipment, reconnect the vacuum hose at port "S", reconnect the air hoses at outlets "A" and "B" and tighten all hose clamps.

V. Differential Vacuum Valve (Decel) Functional Check

- A. Determine if the air by-pass valve controls are functioning properly by performing the following operations.
1. If necessary, warm the engine to normal operating temperature with the transmission in Neutral or Park and parking brake on.
 2. Stop the engine and remove the air manifold check valve hose at the by-pass valve. For a "Tee" system, remove both hoses. Install a tachometer on the engine.
 3. Start the engine. With one hand held over the by-pass valve outlet connections, accelerate to approximately 2500 RPM. Release the throttle for a normal return to engine idle RPM. During the deceleration period, the air flow in the valve outlet should be felt and/or heard to momentarily diminish or stop and then resume as before (normal air flow). Air flow will be discharged thru the exhaust ports in the end of the by-pass valve silencer cover.
The air flow interruption during deceleration cannot be specified due to variations in the rate of deceleration and manifold vacuum.
 4. If the by-pass valve meets its test requirements, but does not function as described in Step 3, check to be sure the decel valve is receiving a vacuum signal. If the decel valve is receiving a signal, then the decel valve is defective and is to be replaced.
 5. Turn off the engine. Remove all test equipment and reconnect all related components of the thermactor system.

VI. Electric PVS (Ported Vacuum Switch) High Temperature Coolant Lock-Out Vacuum Check

Perform SSD-3 for 3-Port PVS.

VII. Thermactor System: Solenoid Vacuum Valve

A. Normally closed Valve, Type 1

1. Determine that the engine air cleaner ambient temperature is above 65° F. and that the engine is at normal operating temperature.
2. While the engine is at idle, disconnect the vacuum hose to the thermactor air by-pass valve. If the thermactor air dumps to atmosphere through the exhaust ports in the end of the valve silencer cover, the solenoid hose connections are correct. Reconnect the vacuum hose.
NOTE: Vacuum supply always goes to the bottom vacuum fitting on the solenoid vacuum valve.
 - Disconnect the vacuum supply hose from the bottom fitting of the solenoid valve and check for manifold vacuum. If vacuum supply is not observed, check and/or replace vacuum sources as required. Reconnect the vacuum hose.
3. Disconnect wiring to the solenoid vacuum by-pass valve.
 - a. Determine which wire has B+ voltage when the ignition switch is in the run position.

- b. Connect wire which has B+ voltage to the solenoid vacuum valve.
4. While the engine is at idle:
 - a. Ground the other exposed terminal on the solenoid vacuum valve to chassis ground. Thermactor air should not dump to atmosphere.
 - b. Connect the wire removed in Step 3a to the solenoid vacuum valve. Thermactor air should not be dumped to atmosphere.
 5. Replace solenoid vacuum valve if the conditions of 4a are not met. Remove test equipment and reinstall related system components.

B. Normally Opened Valve, Type 2

1. Determine that the air cleaner ambient temperature is above 65° F, and that the engine is at normal operating temperature.
2. While the engine is at idle, disconnect the vacuum hose to the thermactor air by-pass valve. If the thermactor air dumps to atmosphere thru the exhaust ports in the end of the valve silencer cover, the solenoid hose connections are correct. Reconnect the vacuum hose.
NOTE: Vacuum supply always goes to black input nozzle on the solenoid valve.
3. Disconnect the wiring to the solenoid vacuum valve.
 - a. Determine which wire has B+ voltage when the ignition switch is in the run position.
 - b. Connect the wire which has B+ voltage to the solenoid vacuum valve.
4. While the engine is at idle, ground the other exposed terminal on the solenoid vacuum valve to chassis ground. Thermactor air should be dumped to atmosphere.
5. Connect the wire removed in Step 3-a. to the solenoid vacuum valve. Thermactor air should not be dumped to atmosphere.
6. Replace the solenoid vacuum valve if the conditions of Step 5 are not met. Reinstall related system components.

VIII. Vacuum Reservoir Check (Required on some Catalyst Control Systems).

- A. Disconnect the vacuum hose on the reservoir which connects to the electric solenoid valve vacuum nipple.
- B. Connect a vacuum gauge to reservoir.
- C. Remove the manifold hose from the reservoir and connect an external vacuum source to this nipple. Apply 14 in. Hg. vacuum to the reservoir and trap. Vacuum on the gauge should not drop more than 1 in. Hg. in one minute. Replace reservoir if out of specification.
- D. Remove all test equipment, reinstall the vacuum lines to the reservoir and torque all clamps and air cleaner.

IX. Vacuum Delay Valve Check (Only required on vehicles equipped with a delay valve in the by-pass valve vacuum line).

- A. **Delay Valve Functional Test**
Perform SSD-2 as applicable.

X. Temperature Vacuum System (TVS) Valve
(Only on applicable models).

See Procedure SSD-9 (Air Cleaner Temperature Control).

XI. Thermactor Idle Vacuum Valve Diagnostic Procedure

A. Preparation

NOTE: Insure that the by-pass valve is functioning properly, according to SSD-5, Section IV.

1. Remove the thermactor idle vacuum (TIV) valve from the connector on the air by-pass valve.
2. Install a vacuum hose on the small nipple on the TIV valve and connect it to one leg of a 3-way "Tee".
3. Connect the second leg of the "Tee" to a vacuum gauge and connect the third leg of the "Tee" to the connector on the by-pass valve.
4. Connect a vacuum gauge to the intake manifold.
5. Warm the engine to normal operating temperature.

B. Procedure

1. With the engine at idle, in Neutral, disconnect the hose at the large diameter port of the TIV, and from another vacuum source, apply 3 1/2 to 4 in. Hg. to the large port.
Vacuum level on the gauge at the by-pass valve should increase to within 3 in. Hg. of intake manifold vacuum level.
2. If the vacuum does not increase to within 3 in. Hg. of intake manifold vacuum, the TIV is damaged and must be replaced.
3. If the gauge reading does not drop below 1.0 in. Hg. when the 3 1/2 to 4 in. Hg. vacuum is removed from the TIV, then replace the TIV.
4. Remove all test equipment and reconnect all vacuum hoses, connectors and the TIV valve.

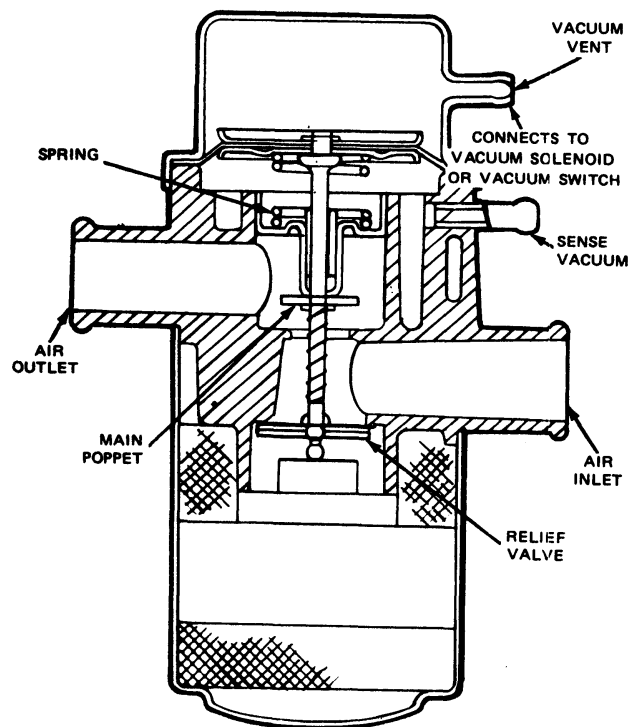
XII. Air By-Pass Valve Functional Tests (Normally Open, Timed By-Pass Valve with Vacuum Vent—Fig. 6).

A. Determine if the air by-pass valve is functioning properly by performing the following operations:

1. If necessary, warm the engine to normal operating temperature with the transmission in Neutral or Park and the parking brake on.
2. Stop the engine and remove the air by-pass valve to the check valve hose at the by-pass valve. For a "Tee" system, remove both hoses connecting the by-pass valve to the check valves. Cap the by-pass valve vacuum vent nipple. Remove, or by-pass, any restricting or delaying device in the sense vacuum hose. Install a tachometer on the engine.
3. With the transmission in Neutral or Park and the parking brake on, start the engine. Accelerate the engine to 1500 RPM. Verify that air is flowing from the air by-pass valve hose outlet connection(s). Air flow should be felt and heard. If no air flow is detectable, the valve is defective and must be replaced.
4. With the transmission in Neutral or Park, and the parking brake on, accelerate to 1500 RPM.

With your hand held over the by-pass valve outlet, momentarily (approximately 5 to 8 Seconds), pinch off the sense vacuum hose to the by-pass valve to simulate the air by-pass cycle. Release the pinched hose. Air flow through the by-pass valve should be felt and heard to diminish or stop for a short period of time, then resume as before (normal air flow). The length of time required to resume normal air flow cannot be specified since the time interval is dependent on engine vacuum, and the length of time the vacuum line is pinched off. Air will be discharged through the exhaust ports in the valve silencer cover. If this cycle does not occur, the valve is damaged and must be replaced.

5. Remove the cap from the vacuum vent nipple, and leave nipple open.



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FIG. 6 Normally Open Timed Air By-Pass Valve with Vacuum Vent

6. Accelerate the engine to 1500 RPM. Virtually no air flow should be detectable from the by-pass valve outlet(s). Air will be discharged from exhaust vents in the silencer housing. If air flow can be felt and heard at the by-pass valve outlet(s) the valve is damaged and must be replaced.
7. Stop the engine. Connect the hoses to the sense vacuum nipple and the vacuum vent nipple.
8. Install the thermactor pump pressure gauge (Rotunda Tool #T75L-9486-A or equivalent) to the air by-pass valve outlet. If the air by-pass valve has two outlets, plug the one without the tester. Start the engine and increase the engine

speed according to the chart in 2. H. and observe the pressure produced at the test gauge(s).

9. Turn off the engine, remove all test equipment and connect the air supply hose(s) to the air by-pass valve(s), and tighten all clamps.

XIII. EGR Vacuum Load Control Valve Test

- A. With the engine warmed up, tachometer connected, and engine off, remove the air cleaner assembly from the carburetor without disconnecting the vacuum hoses.
- B. Disconnect the vacuum reservoir hose at the EGR vacuum load control valve and connect a vacuum gauge to the EGR vacuum load control valve. Disconnect the vacuum supply hose from the venturi port of the carburetor at the vacuum load control valve.
- C. Start the engine and raise the speed to 1200 - 1500 RPM in Neutral and observe the signal on the gauge:
 1. If the vacuum signal is less than 4.0 in. Hg., replace the EGR vacuum load control valve.
 2. If the vacuum signal is 4.0 in. Hg. or greater, apply one of the following vacuum levels from an external source to the venturi port of the load control valve and observe the first gauge signal:

Decal Color of EGR Vacuum Load Control	Vacuum Level (in. Hg) Applied to Venturi Port
Blue	3.0
Red	4.5

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If the first gauge signal does not drop to less than 2.0 in. Hg., replace the load control valve. If the gauge signal drops to less than 2.0 in. Hg. and does not return to greater than 4.0 in. Hg. when external source vacuum is removed from the venturi port, replace the vacuum load control valve.

XIV. Thermactor Vacuum Vent Valve Functional Test

- A. Disconnect the vacuum tubing or connector block from the valve (not the orientation for reinstallation).

NOTE: It may be necessary to remove the valve from the bracket or air cleaner tray to gain access to the vacuum ports on the valve.
- B. Connect the black port to a manifold vacuum source.
- C. Connect an external vacuum source to the white (or body) vacuum port.
- D. With the engine at idle, in Neutral, apply 10 in. Hg. vacuum to the white port and trap. If 10 in. Hg. cannot be obtained, replace the valve.
- E. Remove the manifold vacuum source line from the black port.

The trapped vacuum should drop to Zero. Replace the valve if the trapped vacuum does not drop to Zero.

- F. Remove all test equipment, reconnect all vacuum hoses and connectors and reinstall the valve and air cleaner assembly.

XV. Thermactor PVS with Two Connectors Functional Check

Perform the appropriate test in SSD-3.

XVI. Vacuum Check Valve Operation.

Perform the appropriate test in SSD-2.

XVII. Vacuum Reservoir Check

- A. Disconnect vacuum hoses from both ends of the vacuum reservoir.
- B. Plug one end with a vacuum cap.
- C. Connect Rotunda Tool #21-0014 with a small hose to the open end of the reservoir and apply vacuum of 10 in. Hg. Vacuum should hold for 10 Seconds. If vacuum is less than 10 in. Hg. after 10 Seconds, replace the vacuum reservoir.

XVIII. Check Valve Test

- A. With the engine stopped, inspect the hose(s) from the check valve to the by-pass valve for any leaks due to cracks, splits, holes, etc. Replace if required.
- B. Inspect the hose clamp(s) at the check valve for being properly positioned and tightened. Correct, position, tighten or replace as required.
- C. Disconnect the thermactor hose(s) from the check valve at the by-pass valve end.
- D. Connect the thermactor check valve tester (Rotunda Tool #T75L-9487-A or equivalent) to the open end of the check valve hose. Position the hose clamp and tighten.
- E. Squeeze the rubber bulb, on the tester, to force as much air from the bulb as possible. Quickly release the bulb and start timing. The bulb should remain collapsed for at least 15 Seconds.
- F. If the test bulb does not return to its original free shape for 15 Seconds, the check valve and hose are good. Remove the tester, reinstall the hose and tighten the clamp.
- G. If the test bulb returns to its original free shape in 15 Seconds or less, both hose and check valve are questionable.
- H. Remove the test bulb from the end of the hose. Remove the hose from the check valve. Install a 6 to 18 inch length of appropriate diameter hose to the check valve and test bulb. Position and tighten to specification, a hose clamp at each end of the hose. Repeat step E above.
 - I. If the test bulb does not return to its original free shape for 15 Seconds, the check valve is good.
 - J. If the test bulb returns to its original free shape, in 15 Seconds or less, the check valve is damaged and is to be replaced.
- K. Test the new check valve for leaks.

XIX. Thermactor System Noise Test

NOTE: The thermactor system is not completely noiseless. Under normal conditions, noise rises in pitch as engine speed increases. To determine if excessive noise is the fault of the air injection system, disconnect the drive belt and operate the engine. If the

noise disappears, proceed with the following diagnosis:

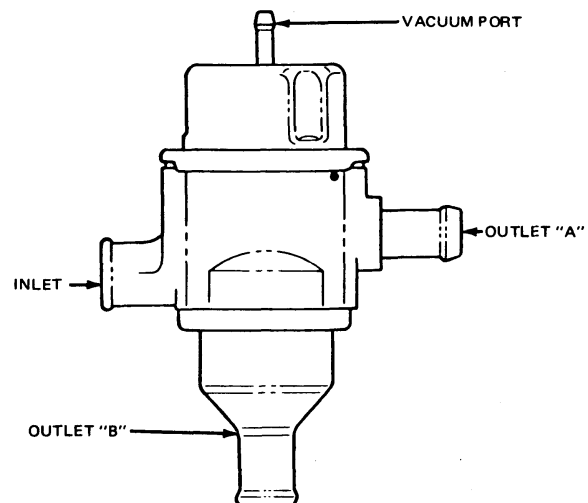
CONDITION	POSSIBLE CAUSE	CORRECTION
Excessive belt noise.	- Loose belt. - Seized pump. - Loose pulley. - Loose or broken mounting brackets or bolts.	- Tighten to specification* using tool #T75L-9480-A to hold belt tension and Belt Tension Gauge #T63L-8620-A. CAUTION: Do not use a pry bar to move the air pump. - Replace pump. - Replace pulley and/or pump if damaged. Tighten bolts to specification (130-180 in-lbs). - Replace parts as required and torque bolts to specification.
Excessive pump noise (chirps, squeaks and ticks).	Insufficient break-in or worn or damaged pump.	Check the thermactor system for worn or damaged parts and make any necessary corrections. If less than 500 miles in service, allow for a 500 mile break-in period. Replace the pump if the noise continues after a 500 mile break-in period.
Excessive mechanical clicking noise.	- Over-torqued mounting bolt. - Excessive flash on the air pump adjusting arm boss. - Distorted adjusting arm. - Adjusting arm bolt too long (bottom of the bolt boss is pushed in).	- Tighten to 25 ft-lbs. - Remove flash from the boss. - Replace adjusting arm. - Replace pump using a proper length bolt.
Excessive thermactor system noise (putt-putt, whirring or hissing).	At Driving Speeds and at Idle - Leak in hose. - Loose, pinched or kinked hose. - Hose touching other engine parts. - By-pass valve inoperative. - Check valve inoperative. - Pump mounting fasteners loose. - Restricted or bent pump outlet fitting. At Idle Only - Worn or damaged pump. - Air dumping through by-pass valve.	- Locate source of leak using soap solution and replace worn or damaged hoses. - Reassemble, or straighten or replace hose and clamps as required. - Adjust hose to prevent contact with other engine parts. - Test by-pass valve and replace if found damaged. - Test check valve and replace if found damaged. - Tighten fasteners to specification. - Inspect fitting and remove any flash blocking the air passage way. Replace bent fittings. - Replace pump. - On many vehicles the thermactor system has been designed to dump air at idle to prevent overheating the catalyst. This condition is normal. Determine that the noise persists at operating speeds before replacing the air pump.

*Refer to Truck Service Specifications Book.

CA4607-2C

XXI. Thermactor Air Control Valve (Fig. 7)

- Remove the hoses from outlets A and B.
- Install a tachometer on the engine.
- Disconnect and plug the vacuum hose from the valve.
- With the transmission in Neutral or Park and the parking brake on, start the engine and accelerate to 1500 RPM. Air flow should be heard and felt at outlet B. If no air flow is detected, perform or review Steps IV. A. 1 thru 3.
- If air flow is verified at outlet B, there should be virtually no air flow at outlet A. If air flow is detected at outlet A, replace the valve.
- Apply at least 8" Hg continuous vacuum to vacuum nipple (reconnect vacuum hose if vacuum is present).
- Air flow should be heard and felt at outlet A and virtually no air flow at outlet B. If either of these conditions is not met, replace the valve.
- Stop the engine, remove test equipment and restore connections.



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FIG. 7 Air Control Valve

SSD-6 CARBURETOR ICING

Generally, carburetor icing can occur if the outside temperature is 30° to 50° F and the relative humidity is 75 percent or greater. The symptoms of carburetor icing are engine roughness or stalling on high cam or closed throttle modes, generally within the first five miles of a cold start and driveway.

- I. Review driver's complaint to see if the above conditions and symptoms existed at the time of the complaint.
- II. If carburetor icing is suspected, perform the SSD-9, air cleaner temperature control and delay valve, and SSD-10, exhaust heat control valve.

SSD-9 AIR CLEANER TEMPERATURE CONTROL SYSTEM

Thermostat Operated System (With Vacuum Override) Check

Note: On engines equipped with an air cleaner retard delay valve, check the delay valve per SSD-2, Step II.

CAUTION: DO NOT WET OR IMMERSE ANY PORTION OF THE VACUUM MOTOR IN WATER.

1. Disconnect duct and valve assembly from air cleaner, all hoses, ducts or other components and remove.
2. Check duct door for freedom of operation. Repair or replace as required.
3. With ambient temperature less than 73° F check operation of duct door, using an external vacuum source, as follows:
 - a. At zero vacuum on vacuum motor, the duct door must be within .60 inch or less of being in the heat-off position. If the door is not in this position after ten minutes, replace the duct and valve assembly.
 - b. With application of 1-5 inches Hg input vacuum to the vacuum motor, the duct door should start to move toward the heat-on position, repair or replace as required.
 - c. With application 7-12 inches Hg input vacuum, the duct door should be in the heat-on position. If the duct door is not in this position within one minute, repair or replace as required.
4. Do not allow vacuum to drop below 7 inches Hg or rise above 12 inches Hg while performing the following water immersion test:
 - a. Insert duct and valve assembly in water so that the bulb end of thermostat is submerged in water and check operation of duct door.
 - b. With water temperature at 50-60° F, the duct door should be in the heat-on position. If the duct door is not in this position within 10 minutes, replace the duct and valve assembly.
 - c. With water temperature at 120-130° F, the duct door should start to move toward the heat-off position. If the duct door does not start to move toward the heat-off position, within ten minutes, repair or replace as required.
5. Remove duct and valve assembly from water and disconnect vacuum from vacuum motor.

CAUTION: THE DUCT AND VALVE ASSEMBLY MUST BE COMPLETELY DRY BEFORE REINSTALLATION.

6. Reinstall duct and valve assembly to air cleaner and reconnect system components.
7. Inspect all components for proper installation and/or damage. Repair or replace as required.

Thermostat Operated System (Without Vacuum Override) Check

Water Immersion Test

1. Disconnect the duct and valve assembly from air cleaner, zip tube and heat riser tube and remove.
2. Check duct door for freedom of operation. Repair or replace as required.
3. Insert duct and valve assembly in water so that the end of wax pellet is submerged and check for operation of duct door as follows:
 - a. With water temperature between 90-105° F, the duct door should be in the heat-on position. If the duct door is not in the heat-on position within 5 minutes, replace duct and valve assembly.
 - b. With water temperature between 130-150° F, the duct door should start to move toward the heat-off position. If the duct door does not start to move toward the heat-off position within 5 minutes, replace duct and valve assembly.
 - c. With water temperature between 150-160° F, the duct door should be in full heat-off position within 10 minutes after immersion. If the valve is not in the full heat-off position within 10 minutes, replace the valve assembly.
4. Reinstall duct and valve assembly to air cleaner and reconnect system components.

CAUTION: The duct and valve assembly must be completely dry before re-installation.

5. Inspect zip tube and heat riser tube for proper installation and/or damage. Repair and/or replace as required.

Section: Vacuum-Operated System Check

CAUTION: This check must be performed in ambients of not less than 60° F. Do not immerse any part of the vacuum-operated duct and valve assembly in water.

NOTE: On engines equipped with an air cleaner retard delay valve, check the delay valve per SSD-2, Step II.

A. Duct and Valve Functional Check

NOTE: On vehicles equipped with a cold weather modulator, bypass the modulator by connecting the two vacuum lines from the modulator.

1. Apply parking brake and block wheels.
2. Remove the air cleaner cover and element. Inspect heat riser tube and zip tube for proper installation and/or damage. Repair or replace as required.
3. Remove items necessary to see the duct door.
4. On units which are vacuum-operated, remove the vacuum line at the duct and valve. Look to confirm that the duct door is in the open (fresh air side) position. If the duct door is in the closed position, check for binding and sticking. Repair or replace as required.
5. Place a magnetic-based temperature indicator (Kent-Moore J22973 or equivalent) as near as possible to the temperature sensor on the air inlet side.

NOTE: Do not allow the temperature indicator magnet to touch the temperature sensor.

If the air cleaner is aluminum, loop a piece of electrical or masking tape (adhesive side out) and press it against the temperature indicator magnet. Press the tape and the indicator against the air cleaner, as near as possible to the temperature sensor on the inlet side.

6. Start the engine. If the duct door is in the heat-on position, proceed to Step 7. If the duct door is in the heat-off position, turn off the engine. Cool the temperature sensor by spraying with liquid from a small can of R-12 refrigerant and a ZRE-6271 or equivalent can adapter for 20 seconds after liquid contacts sensor.

CAUTION: Do not cool the temperature sensor while the engine is running. If R-12 refrigerant is drawn into the carburetor while the engine is running, poisonous phosgene gas will be exhausted into the test area. Conduct this procedure only in a well-ventilated area.

Restart the engine. If the duct door is in the heat-on position, proceed to Step 7. If duct door is in the heat-off position during idle, check related vacuum system per Appendix "A".

7. Reinstall the air cleaner cover without installing the wing nut(s).
8. With the engine running, observe the duct door. When the duct door starts to open, remove the air cleaner cover and note the temperature reading of the temperature indicator. It should be within the following specifications:
 - For sensors color-coded with a brown stripe: temperature should not exceed 90°F.
 - For sensors color-coded with a black or pink stripe: temperature should not exceed 100°F.
 - For sensors color-coded with a blue or yellow stripe: temperature should not exceed 115°F.
- a. If the temperatures are greater than those specified above, replace the sensor.

- b. If the duct door does not start to open within 5 minutes, remove the air cleaner cover and note the temperature. If the temperature is less than those specified above, the temperature is insufficient to operate the duct door. Reinstall the air cleaner cover without installing the wing nut(s) and run engine until the specified temperature is reached. If the duct door has not started to open by then, replace the sensor.

9. Turn off the engine. Remove all test instruments and check to insure that no extraneous dirt or sand is on the air cleaner tray or cover on the inside of the air cleaner element. If dirt is apparent, the assembly should be cleaned per the maintenance procedure.

Reinstall the system components and tighten with wing nut to specification.

B. Cold Weather Modulator (Only on applicable models)

1. Cool the cold weather modulator to 40°F or less. The modulator can be cooled by spraying with liquid R-12 refrigerant and a ZRE-6271 can adapter or equivalent. Allow sufficient time for the modulator temperature to stabilize and the modulator valve to close.
- a. With black cold weather modulator, cool to 20°F.

CAUTION: Do not cool the cold weather modulator while the engine is running. If R-12 refrigerant is drawn into the carburetor while the engine is running, poisonous phosgene gas will be exhausted into the test area. Conduct this procedure only in a well-ventilated area.

2. A 24 inch length of 1/4 inch ID vacuum hose should be used between the cold weather modulator and the vacuum gage. Using an external vacuum source, apply a minimum of 16 inches of vacuum to the vacuum motor side of the modulator and trap. The modulator must hold at least 5 inches Hg vacuum for 30 seconds, otherwise replace the modulator.

3.a. With Blue CWM No. D5DF-9E862-AA

Warm the modulator to 70°F or above. The modulator should not hold vacuum at or above this temperature. If the modulator does not function as indicated, it must be replaced.

b. With Green CWM No. D7ZE-9E862-AA

Warm the modulator to 80°F or above. The modulator should not hold vacuum at or above this temperature. If the modulator does not function as indicated, it must be replaced.

c. With Black CWM No. E0EE-9E862-AA

The modulator should not hold vacuum above 45°F. If modulator does not function as indicated, it must be replaced.

C. Cold Temperature Actuated Vacuum System (Only on applicable models)

Temperature Switch Functional Test (Type 1 and Type 2)

1. Disconnect the connector from the wiring harness.

2. Connect the leads from an ohmmeter or self-powered test light to the temperature switch connector terminals.
3. Cool the switch to a temperature below 40°F. The switch can be cooled by spraying liquid from a small can of R-12 refrigerant with a ZRE-6271 can adapter.

CAUTION: Do not spray the switch with liquid R-12 refrigerant while the engine is running. If R-12 refrigerant is drawn into the carburetor while the engine is running, poisonous phosgene gas will be exhausted into the test area. Conduct this procedure only in a well-ventilated area.

When the switch is cooled below 40°F.

- a. (Type 1) The internal switch contacts should be open. The ohmmeter should read maximum resistance and the test light **should not** light. If the switch does not open below 40°F, replace the switch.
 - b. (Type 2) The internal switch contacts should be **closed**. The ohmmeter should read zero resistance and the test light **should** light. If the switch does not close below 40°F, or if the ohmmeter indicates a resistance value of one ohm or more, replace the switch.
4. Increase the switch temperature until the temperature is above 70°F. The switch temperature can be increased by placing the palm of the hand on the metal surface of the switch or by starting the engine and allowing the exhaust manifold heat to increase the intake air temperature. When the switch temperature is above 70°F:
 - a. (Type 1) The switch contacts should be closed. The ohmmeter should read zero resistance and the test light **should** light. If the switch does not close, or if the ohmmeter indicates a resistance of one ohm or more, replace the switch.
 - b. (Type 2) The switch contacts should be open. The ohmmeter should indicate a maximum resistance and the test light **should not** light. If the switch does not open, replace the switch.
 5. If it is necessary to replace the switch, check the operation of the new switch before connecting the wiring harness connector.

D. Temperature Vacuum System Valve (Only on applicable models)

1. TVS Valve—Normally Opened—White

- a. Cool the TVS valve to 40°F or less. The valve can be cooled by spraying with liquid R-12 refrigerant and a ZRE-6271 can adapter or equivalent. Allow sufficient time for the valve temperature to stabilize and the TVS valve to close.

CAUTION: Do not cool the TVS valve while the engine is running. If R-12 refrigerant

is drawn into the carburetor while the engine is running, poisonous phosgene gas will be exhausted into the test area. Conduct this procedure only in a well-ventilated area.

- b. A 24-inch length of 1/4 inch ID vacuum hose should be used between the TVS valve and a vacuum gauge. Using an external vacuum source, apply a minimum of 16 inches Hg vacuum to the 1/4 inch OD port of the TVS valve and trap. The TVS must hold at least 5 inches Hg vacuum for 30 seconds, otherwise replace the TVS valve.
 - c. Warm the valve to 80°F or above. The valve should not hold vacuum at or above this temperature. If the valve does not function as indicated, replace the TVS valve.
- 2. TVS Valve—Normally Closed—Red**
- a. Heat the valve to 80°F or above. Attach a 24 inch length of vacuum hose (1/4 ID) between the 1/4 inch port of the TVS valve and a vacuum source and gauge. Apply and trap 16 inches of mercury vacuum minimum in the valve system. The TVS valve must hold at least 5 inches mercury vacuum for 30 seconds, otherwise replace valve.
 - b. Cool the TVS valve to 40°F or less. The valve can be cooled by spraying with liquid R-12 refrigerant and a ZRE-6271 can adapter or equivalent. Allow sufficient time for the valve temperature to stabilize and the TVS valve to open. The valve should not hold vacuum at or below this temperature; if it does, it must be replaced.

CAUTION: Do not cool the TVS valve while the engine is running. If R-12 refrigerant is drawn into the carburetor while the engine is running, poisonous phosgene gas will be exhausted into the test area. Conduct this procedure only in a well-ventilated area.

APPENDIX "A"

- A. Check air cleaner vacuum system integrity. Repair or replace as required.
- B. Check the duct door for sticking or binding by depressing with fingers and allowing the internal vacuum motor spring to return the door to the normal position. Correct any sticking or binding before proceeding with test.
- C. Disconnect the vacuum hose from the vacuum motor connector tube. Using an external vacuum source, apply a minimum of 16" Hg vacuum and trap. The vacuum motor should remain closed for 60 seconds. If not, replace the duct and valve assembly.
- D. When replacing the element or reinstalling the air cleaner assembly, follow the instructions included in the maintenance procedure.

SSD-10 EXHAUST HEAT CONTROL VALVE—BIMETAL TYPE(A-3)

1. Inspect valve assembly for any abnormal condition. Repair or replace as necessary.
2. Check valve and thermostatic spring operation by manually rotating the valve shaft. Valve must be free and return to the closed position when cold
3. Lubricate the valve with C0AZ-19A501-A or C4AZ-19A501-A graphite lube or equivalent.

(Rotunda choke tester or equivalent may be used if necessary to cool bimetal spring). If valve cannot be freed or closed, valve must be replaced.

SSD-11 PCV SYSTEM

Application and Requirements (noting any difference between truck lines):

ALL VEHICLES—ALL ENGINES

I. CHECK PCV SYSTEM FUNCTION:

A-1. With the Engine Idling:

1. Remove fresh air inlet of PCV system from rocker arm cover (located on side/end of engine opposite PCV valve).
2. Hold approved Ford PCV valve tester over the opening in the valve cover, making sure there is a positive seal between the tester and cover.
3. Start the engine and allow it to operate at the idle speed.
4. If the ball settles in the good (green) area, the system is functioning properly. If the ball settles in the repair (red) area, servicing of the system is needed.

NOTE: If the No. V-44 PCV Tester is not applicable, use Alternate A-2.

A-2. With Vehicle at Normal Operating Temperature:

1. Remove the PCV valve from its mounting, leaving the valve hose attached. If the valve is functioning properly and not plugged, a hissing air noise will be heard as the air passes through the valve, and a strong vacuum should be felt when a finger is placed over the valve inlet. While finger is over the valve inlet, check for vacuum leaks in the hose line and at all connections.
2. Reinstall the PCV valve, then remove the crankcase air inlet hose at the air cleaner connection. Loosely hold a small piece of stiff paper (such as a 3 x 5 memo card or parts tag card) over the opening at the end of the inlet hose. The paper should be sucked against the

hose opening with a noticeable force after sufficient time has lapsed for the crankcase pressure to lower (usually about a minute or more).

B. With the engine stopped:

Remove the PCV valve from its mounting and shake it. A metallic clicking noise should be heard, indicating the valve is free.

- C. If the PCV system meets the requirements of tests A-1 or A-2 and B, the system is functioning satisfactorily and no further service is required. If it fails any of the tests, replace the PCV valve and clean the PCV system per Step II.

II. CLEAN PCV SYSTEM

1. Remove the PCV System components, filler cap, PCV valve, hoses, tubes, fittings, etc. from the engine.
2. Clean the rubber ventilation hose(s) by passing a suitable cleaning brush through them.
3. Thoroughly wash the rubber hoses in a low volatile petroleum base solvent and dry with compressed air.
4. Thoroughly wash the crankcase breather cap if so equipped in a low volatile petroleum base solvent and shake dry.
5. Thoroughly clean tubes, fittings, connections to assure unobstructed flow of emission gases.
6. Install new PCV valve and reinstall previously removed hoses, tubes, fittings, etc. to their proper location.
7. Replace any system component that shows signs of damage, wear or deterioration as required, particularly rubber hoses that no longer fit snugly onto fittings.
8. Replace any hose or tube that cannot be cleaned satisfactorily.

SSD-12 AUTOMATIC CHOKE SYSTEM

Refer to Maintenance Manual Procedure Part 50-29 D-3 (SSD-12) for Automatic Choke Operational Check.

SSD-13 IDLE FUEL MIXTURE

Propane Enrichment Method

NOTE: Carburetor idle mixture has been adjusted and limiter(s) installed at the factory under controlled conditions. These limiters should not be removed during normal service operations. Idle mixture should be adjusted only during carburetor

repair when specified, or when necessary as a result of government inspection laws.

Adjusting idle mixture by a method other than the following propane enrichment procedure may not be in compliance to Federal/State or Provincial Laws.

1. Set the parking brake and block the wheels. On vehicles equipped with a vacuum parking brake release, disconnect and plug the vacuum hose at the parking brake actuator.

2. Connect an ignition timing light and tachometer to the engine.

NOTE: Use a dampened tachometer with no greater than 20 RPM divisions. Digital tachometers are not recommended for the propane enrichment procedure.

For high energy ignition systems, use an approved tachometer such as the Rotunda 20362 or equivalent.

3. Remove and plug the vacuum line(s) to the distributor.

4. Start the engine and run until normal operating temperature is reached. Turn off all accessories.

CAUTION: Do not allow the engine to idle for extended periods of time. Exhaust System overheating may cause excessive underbody temperatures.

5. Set the initial timing to specification. The engine idle speed during initial timing adjustment must be at or below the speed specified on the Vehicle Emission Control Information label.

6. Reconnect the vacuum line(s) to the distributor.

NOTE: Leave all vacuum signal hoses attached to the air cleaner assembly when relocating the assembly to perform carburetor adjustments. The air cleaner assembly must be in place, however, when measuring engine speeds and during the propane enrichment procedure.

7. Inspect Oil and Air Cleaner.

NOTE: In cases of severe oil dilution by gasoline vapor as in short trip driving in very cold weather, the engine oil and filter should be changed prior to performing the idle adjustment procedure with propane enrichment.

An excessively dirty air cleaner element could cause an erroneous propane reading. If necessary, make any replacements before performing the propane enrichment procedure.

8. Disconnect the evaporative emission purge hose at the air cleaner, if so equipped.

For vehicles, equipped with the fuel evaporative purge valve signal vacuum hose, disconnect the hose as follows:

Trace the purge valve vacuum hose from the purge valve (located on the canister) to the first point where the hose can be detached from the underhood hose routing such as a vacuum tee connection, PVS valve, etc. Disconnect the hose at that point, cap the open port and plug the vacuum hose.

CAUTION: Do not disconnect the vacuum hose at the purge valve to prevent possible damage to the valve.

For vehicles equipped with the fuel evaporative purge return hose, disconnect the hose at the engine and plug the connection.

9. Position idle mixture limiter cap(s) in the maximum rich position. (See Fig. 8.) Idle mixture screw(s) without limiter caps must be turned in to seat lightly and then turn screw out approximately 1-1/2 to 2 turns.

NOTE: On carburetors with more than one mixture screw, the screws must be balanced. When changing the mixture turn the screws in equal turns.

FULL-RICH POSITION
COUNTERCLOCKWISE

FULL-LEAN POSITION
CLOCKWISE

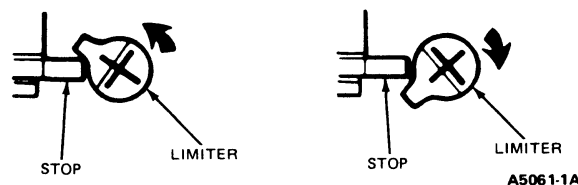


FIG. 8 Idle Mixture Limiter Screw Positions

10. Set the curb idle speed to specification.

NOTE: When performing engine RPM adjustments on vehicles equipped with the hydro-boost brake system, make certain the main brake foot pedal is not depressed—since engine RPM is affected by foot pedal pressure. This precaution should also be observed when adjusting propane idle mixture if the check is to be done in transmission drive position.

Be sure to use the engine curb idle adjustment procedure in the Shop Manual Vol. 5—Pre-Delivery Maintenance and Lubrication Part 50-29, D-2 (SSD-26).

Propane RPM gain readings will be affected by any speed variations.

On vehicles equipped with automatic transmissions, position transmission in DRIVE or NEUTRAL as specified. This is important since the curb idle and idle fuel mixture adjustments may be adjusted in different transmission positions.

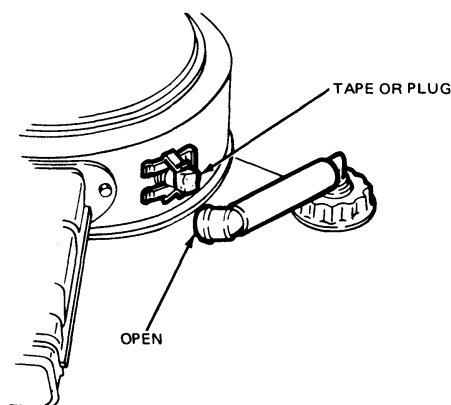
If the tachometer fluctuates during propane or idle set procedures, average the fluctuations to determine the true RPM.

Stabilize the engine idle speed (no further drop) before each idle speed and propane check by positioning the transmission in neutral or park, run the engine to approximately 2500 RPM for 15 seconds before each idle speed and propane enrichment speed gain check.

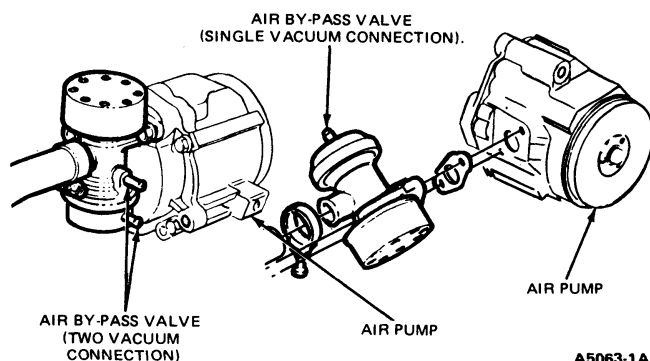
11. Disconnect the crankcase ventilation hose from the air cleaner assembly and plug or tape the air cleaner hole (Fig. 9). This is important as it prevents combustible propane gas from entering the crankcase. Leave the hose open to underhood air to allow the crankcase to vent to atmosphere.

12. For thermactor equipped vehicles, revise the dump valve vacuum hose and/or supply hoses as follows:

NOTE: Every time curb idle speed is adjusted, the thermactor must be connected and the air cleaner must be in place for the final reading.



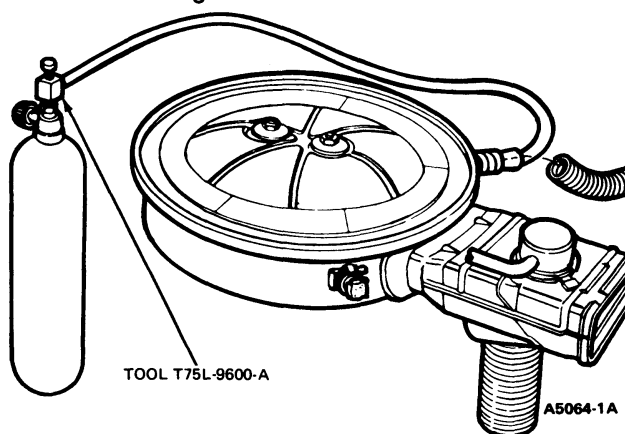
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FIG. 9—Taping Air Cleaner Hole

A5063-1A

FIG. 10—Thermactor Valves

For dump valves with two vacuum fittings, disconnect and plug the hose(s) (Fig. 10). For dump valves with one fitting, remove and plug the hose at the dump valve. Connect a slave hose from the dump valve vacuum fitting to an intake manifold vacuum fitting.

**FIG. 11—Adapting Propane Supply to Air Cleaner**

13. Plug the propane tool T75L-9600-A hose into the air cleaner evaporative purge nipple. See Fig. 11. If vehicle is not equipped with a purge nipple, disconnect the flexible fresh air tube from the air cleaner duct or adaptor. Insert the end of the propane tool hose approximately three-quarters of

the way into the fresh air tube or duct. If necessary, secure the hose with tape.

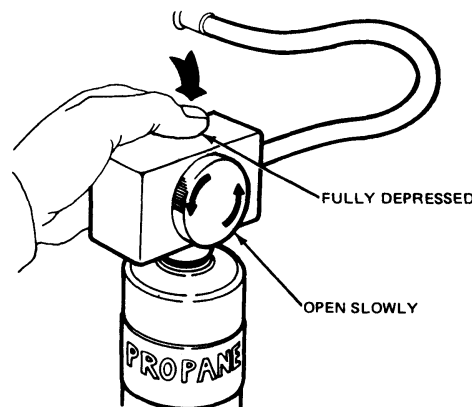
Place the propane bottle in a vertical position with the gas valve at the top.

Hold the gas valve plunger down throughout the check with the engine idle speed constant (after 2500 RPM clean-out).

Be sure the transmission is in the position specified on the Vehicle Emission Control Information label.

Note the idle speed before propane is introduced into the air cleaner.

Slowly open the valve on the side of the propane tool until the engine RPM reaches a MAXIMUM and then drops off (Fig. 12).



A5065-1A

FIG. 12—Opening Propane Tool Valve

Note the maximum increase and compare the gain to the specification.

The gain specification may be found in the Performance Specification Book.

14. If the engine speed increases to a maximum, BUT WILL NOT DROP with both the propane tool plunger down and the side valve in the full open position, do the following:

Use a new propane bottle as the tank may not have a sufficient charge.

—If RPM now reaches a maximum and then drops off, repeat Step 13.

—If the RPM still does NOT drop, remove the valve from the propane tank. Reverse flush the valve with shop compressed air to remove contaminants that may prevent full propane flow. See Fig. 13. Repeat Step 13 if RPM still does NOT reach maximum and drop off, check the propane tool side valve. The valve should be fully open after one to two and one half turns counterclockwise. Repair or replace the valve as required. Repeat Step 13.

15. If propane gain (Step 13) is within specifications, go to Step 17.

16. If propane gain (Step 13) is NOT within specifications:

The idle fuel-air mixture adjustment is necessary. Adjust the idle mixture according to the RESET RPM specification.

Remove the limiter cap(s) from the carburetor idle mixture screw(s). Use Rotunda tool T75L-9500-A or equivalent to prevent screw damage (Fig. 14).

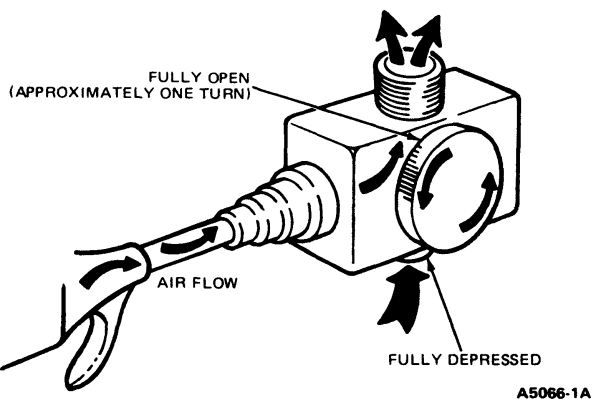


FIG. 13—Reverse Flushing Propane Valve

LIMITER CAP REMOVAL TOOL T75L-9500-A

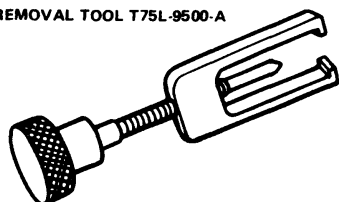


FIG. 14—Idle Limiter Cap Removal Tool

To adjust vehicles with tamper-resistant idle adjustments remove the carburetor. Remove the shield installed over the mixture adjustment as follows:

Removal of Tamper-Proof Feature:**Model 2150 Carburetors (Refer Fig. 15).**

- Remove carburetor.
- Place carburetor upside down and insert the tips of snap on Tool #PR-2491 external snap ring pliers or equivalent in the slot of the idle adjusting needle cap and plug assembly.
- Apply force to separate cap and plug.
- Maintaining this separation force, use a snap on #SSDE-42 thin bladed screw driver or equivalent and carefully separate the plug from the cap.
- Repeat procedure for second idle needle.
- Reinstall carburetor on the vehicle and continue with the idle adjustment procedure.
- Upon completion of the idle adjustment, with carburetor on engine, reinstall the caps with Tool #T80E-9156-A, with indentation on caps pointing to outside of carburetor and the wide slot in the cap over the ear of the power valve cover.

IF SPEED INCREASE IS LOWER THAN SPECIFICATION:

- Lean the mixture without propane by turning the mixture screw(s) clockwise. To approach the correct setting, lean the mixture while watching the tachometer idle speed drop the number of RPM needed to approach the speed gain RESET specification. This is a time saving approximation only.

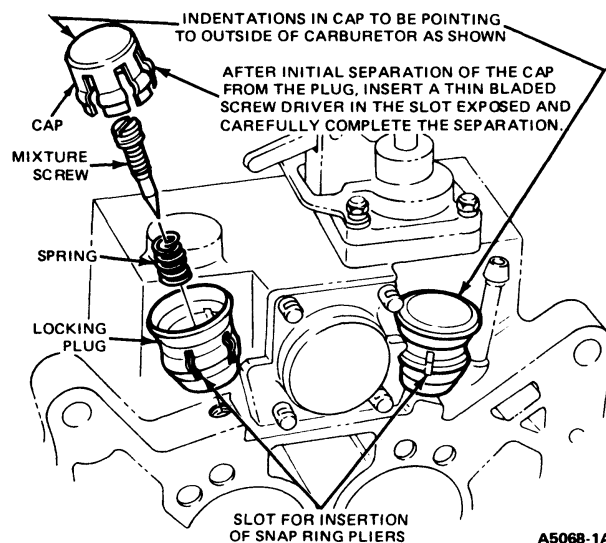


FIG. 15 Removal of Tamper-Proof Feature

EXAMPLE:

Specified RESET increase	—50 RPM
Observed increase	—20 RPM
System rich by	—30 RPM

- On carburetors with more than one mixture screw, turn the screws in equal amounts.
- Reset curb idle speed to specification.
- Recheck the propane gain to the RESET specification. Be sure to run the engine at 2500 RPM to clean out and stabilize the idle speed.
- Repeat the idle mixture adjustment procedure and the curb idle adjustment procedure until the correct RESET propane RPM gain is reached.
- Proceed to Step 17.

IF THE SPEED INCREASE IS HIGHER THAN SPECIFICATION:

- Richen the mixture without propane by turning the mixture screw(s) counterclockwise. To approach the correct setting, richen the mixture while watching the tachometer idle speed increase the number of RPM needed to approach the speed gain setting. This is a time saving approximation only.

EXAMPLE:

Specified RESET increase	—50 RPM
Observed increase	—80 RPM
System lean by	—30 RPM

- On carburetors with more than one mixture screw, turn the screws in equal amounts.
 - Reset curb idle to specification.
 - Recheck the propane gain to the RESET specification.
 - Repeat the idle mixture adjustment procedure and the curb idle adjustment procedure until the correct RESET propane RPM gain is reached.
 - Proceed to Step 17.
17. For all carburetors requiring limiter cap(s), install new blue limiter caps in the maximum rich position. Be sure to use the correct length cap as two types are available (Fig. 16).

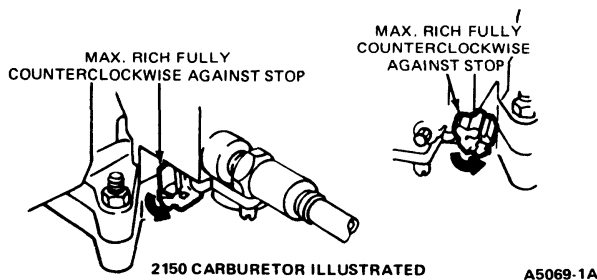


FIG. 16—Positioning New Limiter Caps

Pre-soaking the limiter cap(s) in hot water will soften the material and reduce installation effort. For carburetors equipped with tamper-resistant idle adjustment screw(s), install a new plug over the idle mixture adjustment screw(s).

18. Recheck the engine idle RPM and idle speed gain to be sure idle mixture screw(s) were not disturbed during limiter installation. Correct as required.
19. Turn off the engine. Remove the propane enrichment test equipment. Install the purge tube and fresh air duct as required.
20. Remove the plugs from the fuel evaporative purge valve signal vacuum hose and reconnect the vacuum hose, reconnect the fuel evaporative purge valve return hose at the engine, if applicable.
21. If required, install the air cleaner. Remove the plug or tape from the air cleaner crankcase vent opening and install the hose. Remove the plug from the parking brake vacuum hose and install the hose. Connect all thermactor hoses.
22. Remove all test equipment and check all engine system connections.

SSD-14 IGNITION SYSTEM

To properly diagnose the ignition system, the following steps must be taken:

If for any reason any "Dura Spark" two piece distributor cap (cap and adaptor) must be removed, the top portion of the cap must be removed first, followed by the rotor and then the bottom portion of the cap (adapter).

If any Dura Spark II high tension wire is disconnected, the interior of the terminal boot must be greased with silicone grease (D7AZ-19A331-A) or equivalent before reconnection. This should be performed by applying a thin layer of the silicone grease (using a clean small screwdriver) to the boot interior from the terminal to the end of the boot.

All distributor brass rotor tips have a coating of silicone grease to reduce RFI (radio frequency interference) noise emissions. Do not attempt to remove this silicone coating from the rotor tip or distributor cap electrodes onto which bore of the grease may have transferred. As this compound ages it has the appearance of being a contaminant. This condition is normal and causes no functional or performance problem.

Unless otherwise specified, all high voltage measurements are to be made only with a "clamp on" type high voltage probe connected to the coil to distributor high tension wire.

I. High Voltage Portion (All Engine Lines)

- A. Remove air cleaner, if necessary, plug vacuum lines and visually inspect all wires, connections and related system components for any abnormal conditions. Repair and/or replace as required.

- B. Measure the Ignition System Coil Reserve Voltage.

Specification: **28Kv minimum.**

Connect a Rotunda Diagnostic Console No. 360036 or equivalent capable of displaying high voltage and engine rpm readings to the vehicle. Its "clamp on" voltage pickup must be connected to the coil to distributor high tension wire. With the engine running at 1000 rpm, observe engine operation and read scope pattern for any

abnormal conditions. Note abnormal condition and proceed. With engine running at 1000 rpm, (see Caution below), remove one spark plug wire from its plug, not allowing the wire to arc to ground and read the highest open circuit voltage indicated on the scope.

CAUTION

1. For this test, do not remove the following spark plug wires while the engine is running:
No. 1 or No. 8 Wire on V-8 Engines
No. 3 or No. 5 Wire on I-6 Engines
2. On catalytic converter equipped engines, a spark plug wire should be removed for no more than 30 seconds for the coil reserve and rotor to cap voltage drop tests combined. Engine rpm should be increased to measurement speed before spark plug removal to keep the test time to a minimum.

If this reading fails, the problem may be in the system module, breakerless distributor, the ignition coil, the primary wiring circuits or in the coil to the distributor high voltage wire.

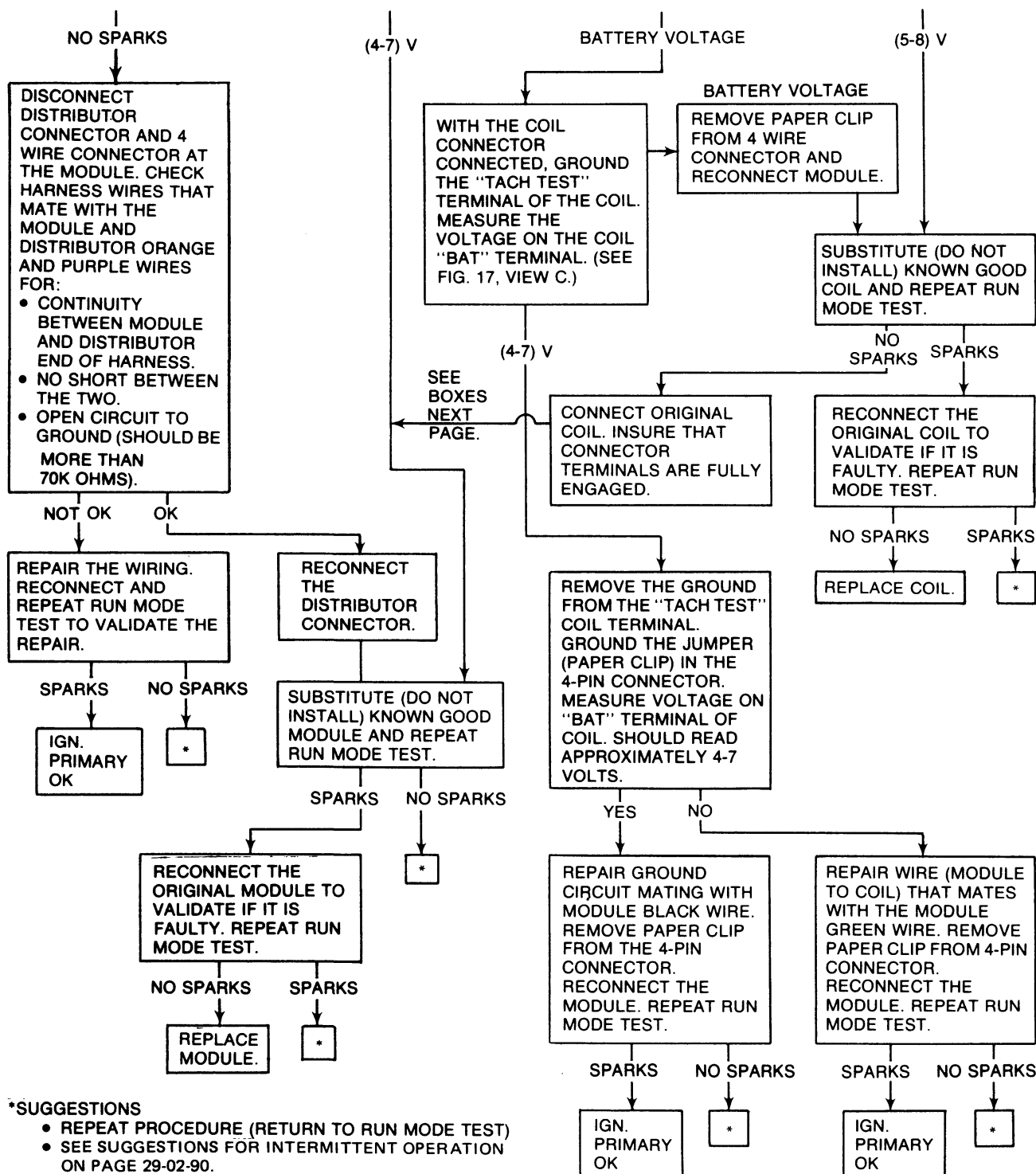
- a. Check coil to distributor high voltage wire. Specification: 5K Ohms per inch max. Replace if required.
- b. Check primary (low voltage) portion. Repair and/or replace as required.

- C. Measure the Distributor Rotor to Cap Voltage Drop.

Specification: **8 Kv Maximum.**

Connect a Rotunda Diagnostic Console No. 360036 or equivalent high voltage probe(s) to the coil to distributor high voltage wire. Remove one spark plug wire from its spark plug and ground the wire to the engine block with an appropriate ground wire connected to the spark plug terminal. Run the engine at idle and do not allow a spark gap to occur between ground and the spark plug wire.

If this test fails, the problem will be either the distributor rotor or the distributor cap, or both. First, replace the rotor and re-run the test. When

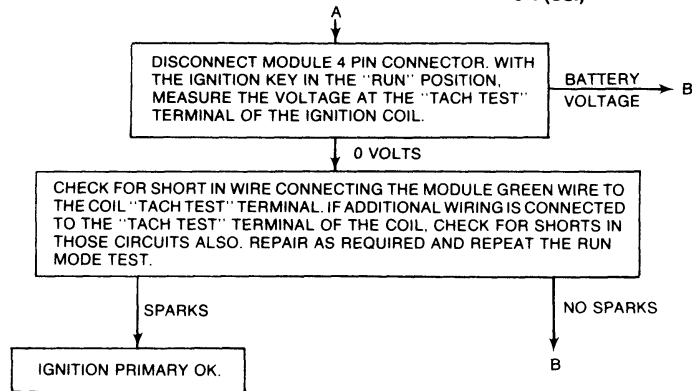


*SUGGESTIONS

- REPEAT PROCEDURE (RETURN TO RUN MODE TEST)
- SEE SUGGESTIONS FOR INTERMITTENT OPERATION ON PAGE 29-02-90.

IMPORTANT

- WHEN REINSTALLING COIL WIRE, COAT THE INSIDE OF THE BOOT WITH SILICONE GREASE (D7AZ-19A331-A or EQUIVALENT) USING A SMALL, CLEAN SCREWDRIVER BLADE.

II. PRIMARY (LOW VOLTAGE) PORTION — CONTINUED**B. DURA SPARK II AND SOLID STATE IGNITION (SSI)**

CA4838-2A

replacing the rotor, the brass electrode tip must be coated approximately 1/32 inch thick on all sides (outward of the plastic) with D7AZ-19A331-A silicone grease Dow 111 or G.E.-G627 compound or equivalent. If the test again fails, replace the distributor cap.

D. Measure Spark Plug Required Voltage

Specification: **6-20 Kv.**

To make this measurement, connect the diagnostic instrument high voltage probe to the coil to distributor high voltage wire. Bring the engine to approximately 2000 rpm, and read the highest spark plug high voltage requirement for each cylinder.

1. If the required voltage falls low, remove the probe from the coil wire and connect it to each spark plug wire to determine which spark plug is low.

Note: When measuring required voltage on individual plug wires, the minimum specification is reduced to 4 Kv.

Remove the spark plug from any cylinder having a required voltage less than approximately 4 Kv and/or significantly lower voltage than other cylinders and inspect for closed gap, bridged cap, fouled insulator nose, or cracked ceramic. Repair or replace as required.

2. If required voltage is more than approximately 20 Kv and/or significantly (50 percent) higher than other cylinders, use the same procedure as shown above (1) to locate the problem cylinder. Check both the spark plug and the high voltage spark plug wire. Remove spark plug and inspect for excessively worn or burnt electrodes, or high resistance between terminal and center electrodes. Repair or replace as required.

E. Spark Plug Wires

Specification: **5K Ohms Per Inch Max.**

To properly inspect the spark plug wire harness, first remove all wires from the spark plugs by

twisting the spark plug boot carefully to loosen its seal on the plug insulator. Remove the wire by pulling on the plug boot. Disconnect the wire separators from the valve covers, and remove the distributor cap from the distributor—leaving the plug wires connected to the cap. Do not remove the spark plug wires from the cap except for replacement. Using an ohmmeter, check the resistance of each wire by connecting one meter lead to the spark plug terminal (use adaptor if available) and the other lead to the distributor cap insert. Replace any wires that are not within specification. Visually inspect the spark plug boots for possible damage due to heat or handling. Replace as required.

II. Primary (Low Voltage) Portion

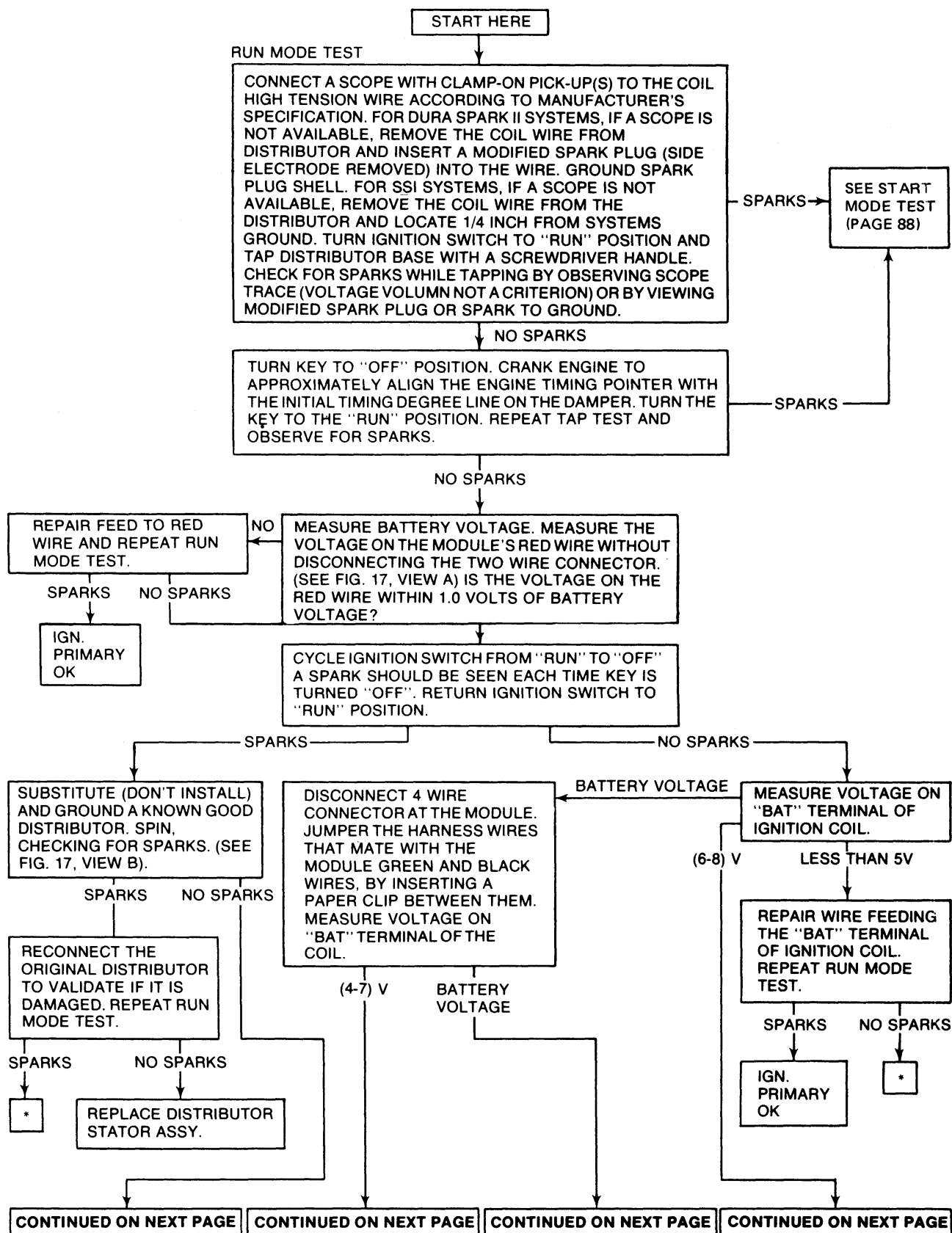
A. Dura Spark II and Solid State Ignition (SSI)

PRELIMINARY NOTES

The Dura Spark II Ignition System is used for all 1980 truck applications except Super Duty trucks which use Solid State Ignition (SSI).

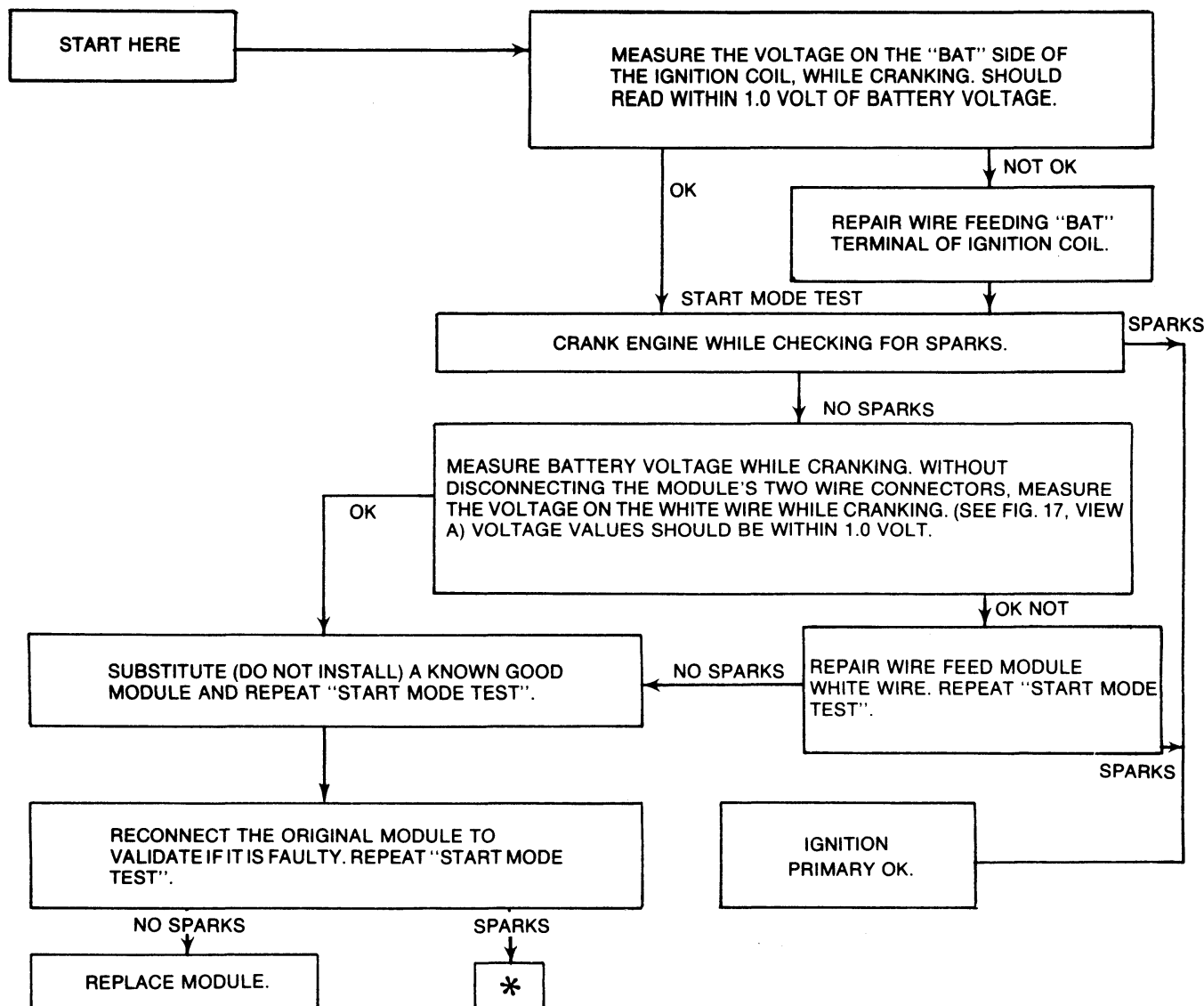
Equipment necessary to conduct this test is:

- Rotunda Diagnostic Console No. 360036 or equivalent or a "modified spark plug" (side electrode removed).
- 2' to 3' jumper wire with No. 60 Mueller alligator clips or equivalent.
- 2' to 3' jumper wire with No. 24A Mueller alligator clips (for spark plug ground) or equivalent.
- One ordinary straight pin.
- One ordinary paper clip.
- One known good breakerless type distributor.
- One known good ignition coil No. D5AE-12029-AB or equivalent.
- One voltmeter, 0-20V range.
- One known good ignition module No. D8VE-12A199-AB or equivalent.



II. PRIMARY (LOW VOLTAGE) PORTION — CONTINUED

B. DURA SPARK II AND SOLID STATE IGNITION — CONTINUED

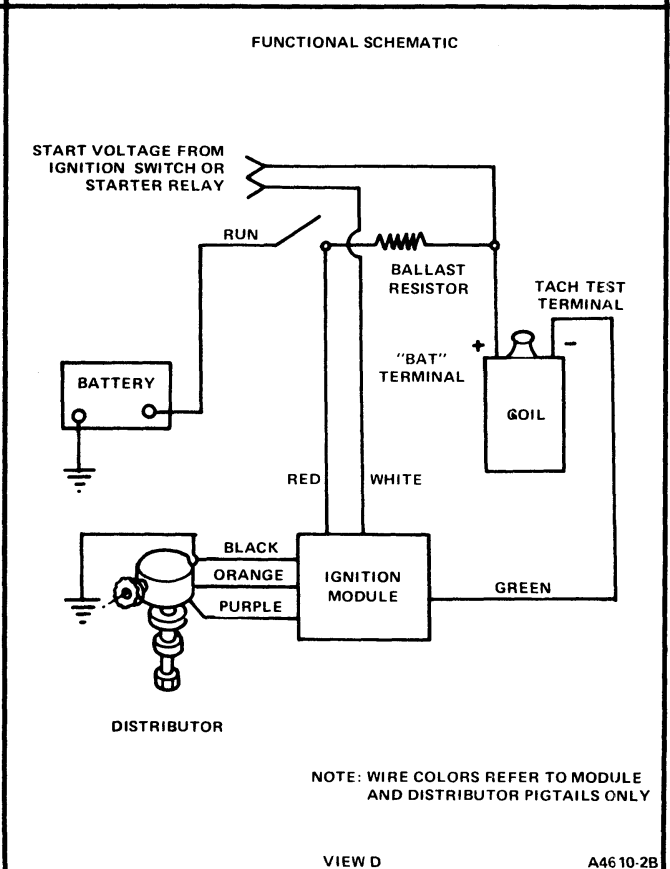
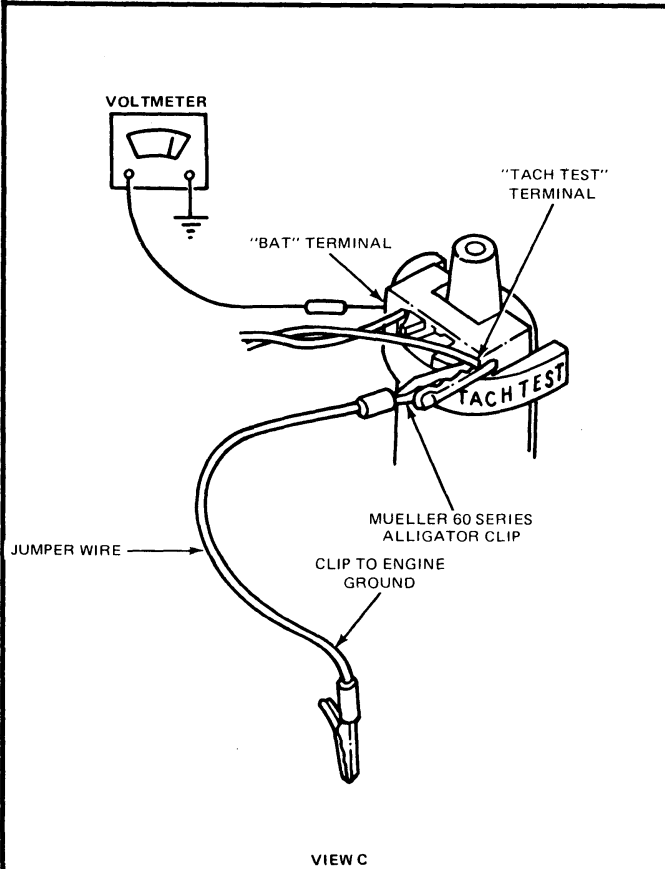
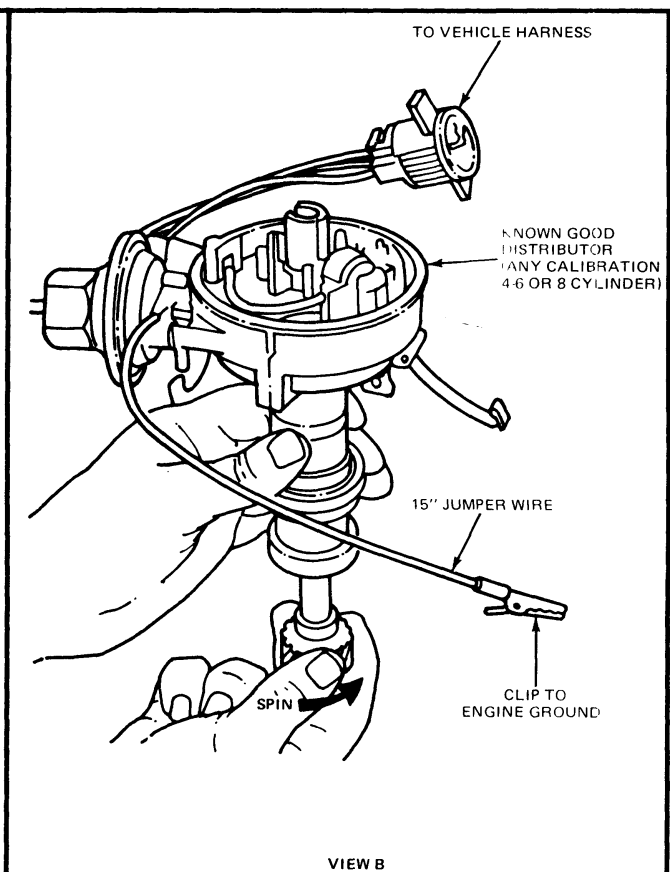
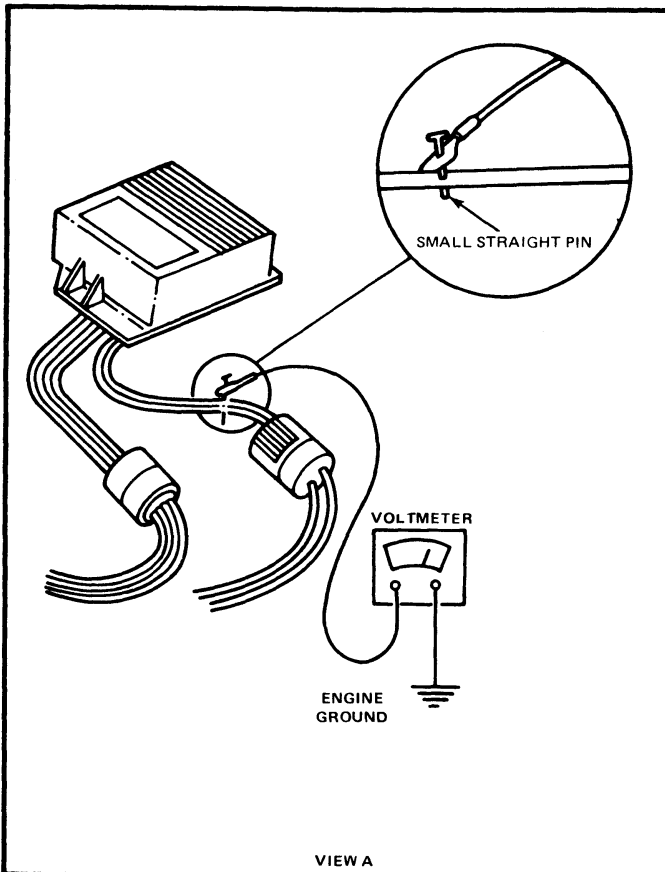


* SUGGESTIONS

- REPEAT PROCEDURE (RETURN TO RUN MODE TESTS).
- SEE SUGGESTIONS FOR INTERMITTENT OPERATION ON PAGE 90.

IMPORTANT

WHEN REINSTALLING COIL WIRE, COAT THE INSIDE OF THE BOOT WITH SILICONE GREASE (D7AZ-19A331-A DOW CORNING III, G.E. G627 OR EQUIVALENT) USING A SMALL, CLEAN SCREWDRIVER BLADE.



*SUGGESTIONS FOR INTERMITTENT OPERATION

DURA SPARK II AND SOLID STATE IGNITION (SSI)

If ignition system becomes operative in the course of performing these procedures and you have not made a repair, it is likely an intermittent connection or an intermittent ignition component has become functional. The following suggestions are offered:

Perform First: With the engine running, attempt to recreate the problem by wiggling the wires at the coil, module, distributor and other harness connectors. Start first with the connections you might have already disturbed. Also check the ground connection in the distributor. Disconnecting and reconnecting connectors may also be helpful.

CAUTION: DO NOT CLEAN GREASE FROM CONNECTORS as it is required to prevent terminal corrosion.

Perform Second: Intermittent Component Testing

Pick-Up Coil: With the engine off, heat the stator pick-up coil by placing a 250 watt heat lamp approximately 1" to 2" from its top surface. Apply heat for 4 to 6 minutes while monitoring pick-up coil continuity between the parallel blades of the

disconnected distributor connector. The resistance should be 400-1000 ohms. Tapping with a screwdriver handle may also be helpful. If not within specs, replace stator assembly.

Ignition Module: With engine running, heat module by placing a 250 watt heat lamp approximately 1" to 2" from the top surfaces of the module. Tapping may also be helpful.

CAUTION: THE MODULE TEMPERATURE SHOULD NOT EXCEED 212°F (BOILING). AFTER THE FIRST 10 MINUTES OF HEATING, CHECK THE TEMPERATURE BY APPLYING A FEW DROPS OF WATER TO THE MODULE HOUSING. REPEAT THE CHECK EVERY TWO MINUTES UNTIL THE WATER DROPLETS BOIL. AVOID TAPPING THE MODULE TO THE EXTENT THAT THE HOUSING IS DISTORTED.

If this procedure results in ignition malfunction, substitute (do not install) a known good module. If the malfunction is corrected by the substitution, VALIDATE THAT THE ORIGINAL MODULE IS WORN OR DAMAGED BY RECONNECTING IT TO THE VEHICLE. A functional check of the original and known good module can quickly be accomplished by using the "RUN MODE TEST."

NOTE: Some modules may require repositioning to be properly heated.

SSD-15 IGNITION TIMING

Application: All engines (Noting any differences between engine lines.)

After adjusting the initial timing, the idle speeds should be checked and, if necessary, re-adjusted.

A. Basic Timing

1. Clean the surface of the front damper and place a white mark on the proper degree line on the damper and pointer according to specification. (Refer to the Vehicle Emission Control Information Decal).
2. Disconnect the vacuum line(s) at the distributor and plug the line(s).
3. Connect a Rotunda timing light No. 270001 or equivalent to the No. 1 cylinder spark plug wire.
4. Connect up a Rotunda tach-dwell No. 20362 or equivalent. Start the engine and warm up. Set timing idle speed to specification, as shown on the Vehicle Emission Control Information Decal.
5. Check engine initial timing. If within ± 2 degrees of the specification shown on the Cooling Emission Control Information Decal, do not reset.
6. If more than $\pm 2^\circ$, loosen distributor hold down bolt and adjust initial timing to specification by rotating the distributor against rotor rotation to advance timing, or with rotor rotation to retard timing. When the white mark (Step 1) is directly in line with pointer, ignition timing is then correct. Torque hold down bolt. Recheck timing after hold down bolt has been torqued.

B. Centrifugal Advance

Check centrifugal advance by accelerating engine (in neutral) to 2500 rpm. If ignition timing advance is noted during acceleration, the centrifugal advance mechanism is functional. If not, remove distributor and replace.

C. Total Advance

1. Install a vacuum gauge in the vacuum line from the carburetor source to the vacuum advance diaphragm (outer diaphragm on dual diaphragm distributors). Increase engine speed to 2500 RPM to verify available vacuum. If no vacuum is available within 60 seconds, vacuum system is at fault, perform SSD-3. If a vacuum is available, perform Step C-2.
2. Install distributor vacuum line (without spark delay valves) to outer diaphragm (on dual diaphragm distributor). Accelerate engine to 2500 RPM. Total advance should now be greater than in part "B" if advance mechanism is functional. If not, replace vacuum advance components as required.

D. Vacuum Retard (Dual Diaphragm Distributor)

1. Install vacuum gauge in vacuum line from the intake manifold source to the vacuum retard diaphragm (inner diaphragm on dual diaphragm distributors). With the engine at idle, verify available vacuum. If vacuum is not available, vacuum system is at fault. Correct as required. If vacuum is available, perform Step D-2.

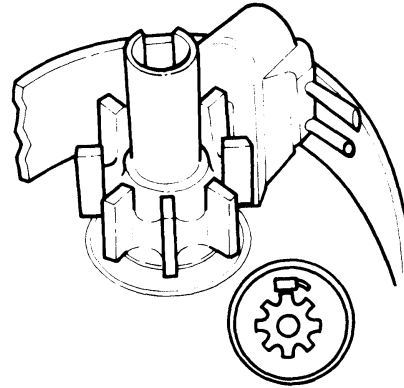
2. Remove the vacuum gauge and reinstall the vacuum line to the retard diaphragm (inner diaphragm on dual diaphragm distributors). Ignition timing should indicate retard. If no retard is indicated, replace vacuum retard components as required.

E. Remove Test Equipment

Appendix "A" (All Ignition Systems)

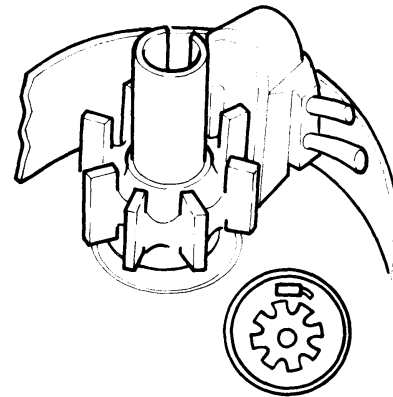
An engine that idles smoothly but becomes rough when accelerated (1000-2000 rpm) can be caused by crossed orange and purple primary ignition wires in the engine harness between the distributor and the module. When this condition exists, the initial timing marks can be properly aligned but the distributor will be as much as 22 degrees from its normal position.

1. With the ignition key off, rotate the engine to initial timing mark firing point.
2. Remove the distributor cap.
 - a. If one of the "spokes" of the armature is opposite, the pole of the stator (Magnetic pick-up coil), the ignition primary circuit is OK. See Fig. 18.
 - b. If the stator pole is between two "spokes", the primary wires are probably crossed. See Fig. 19. If the condition on Fig. 19 is seen, proceed to Step 3.
3. Visually check the color continuity of both the orange and purple wires through the distributor to engine harness connector and through the module to engine harness connector before separating the connectors. (Fig. 17, View A or D).
4. Disconnect the two connectors and check continuity of both the orange and the purple wires through the engine harness.
 - a. If color and electrical continuity in 3 and 4 are good, the problem is not in the orange and purple wire harness. Substitute the distributor stator assembly and/or the ignition module with known good components to check for crossed wires in these components.
 - b. If not, cut open the engine harness, cut, cross, splice, solder and tape wires corresponding to



A4437-1A

FIG. 18 View From Top of Distributor (Correct)



A4438-1A

FIG. 19 View From Top of Distributor (Incorrect)

the orange and purple wires of the distributor and retape the harness.

5. Return the distributor to the normal position and/or reset initial timing per SSD-15 Step A., if required, and verify effectiveness of fix.

SSD-16 FUEL BOWL VENT

2150 Carburetors

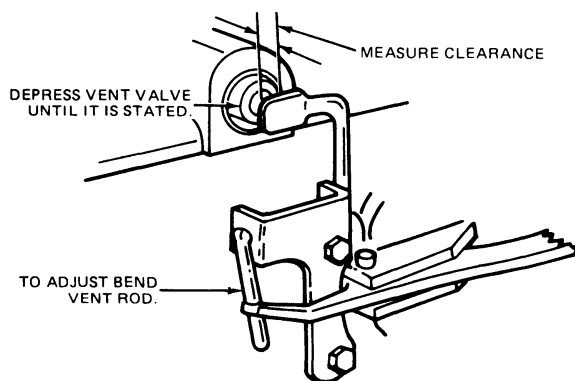
1. Inspect the valve and linkage for damage, leaks and/or proper connections. Repair and/or replace as required.
2. Check for plugged bowl vent tube by connecting a Rotunda vacuum hand pump or equivalent to the bowl vent tube. If the valve maintains a vacuum reading the tube is plugged. Clean, repair and/or replace as required.
3. If necessary, bring engine to normal operating temperature.
4. Check TSP-OFF speed to specification (Refer to the Vehicle Emission Control Information Decal), adjust as required.
5. With TSP deenergized and vent valve plunger depressed, or at mechanical engine curb idle set,

measure the clearance between the vent valve plunger and the actuating lever.

6. Clearance should be within specifications. (Refer to Truck Performance Specifications Book.) Bend actuating lever as required to obtain the specified clearance (Fig. 20).

Solenoid Switch Vent (if so equipped)

1. Remove the air cleaner assembly.
2. Place your hand on the switch vent assembly and turn the ignition switch on and off.
3. If the solenoid activates/deactivates (an audible click should be heard and felt with the hand), reinstall the air cleaner assembly.
4. If the solenoid does not activate/deactivate, disconnect the electrical lead.



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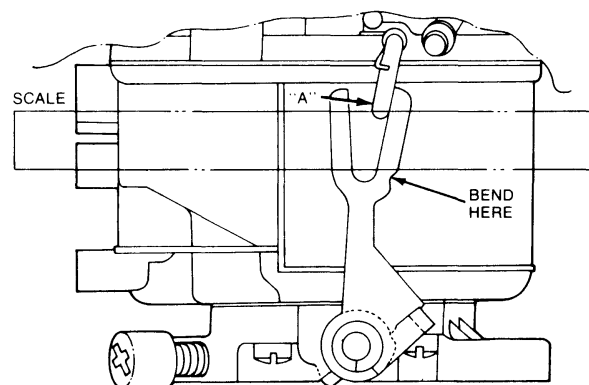
FIG. 20 Bending Actuating Lever

5. Connect the volt meter and insure that voltage is being applied to the solenoid. Repair as required.
6. If the solenoid is receiving applied voltage, check for binding/plugged vent valve. Clean and/or repair as required.
7. If the solenoid valve is not bound or plugged, replace the solenoid/valve assembly.

YFA Carburetors

1. Check curb idle rpm to specification as shown on the Vehicle Emission Control Information Decal, (with solenoid activated, if applicable). Adjust as required.
2. Stop the engine and turn the ignition key to the "ON" position so that the solenoid (if equipped)

- is activated but the engine is not running. Secure the choke plate in the wide-open position.
3. Open the throttle so that the throttle vent lever does not touch the fuel bowl vent rod.
4. Close the throttle and measure the travel of the fuel bowl vent rod at point "A" (Fig. 21) from the open throttle position (Step 3 above) to the idle position (Step 2 above). Travel of the fuel bowl vent rod at point "A" should be within specification. (Refer to Truck Performance Specifications Book.
5. If the travel of the fuel bowl vent rod is not to specification, bend the throttle vent lever as indicated (Fig. 21) to obtain the required travel.



A4840-1A

FIG. 21 YFA Carburetor—Bowl Vent Setting**SSD-17 VALVE TRAIN****I. Removal of Rocker Cover**

- A. Remove air cleaner.
- B. Disconnect and remove any hoses, wires, spark plug leads and components that would interfere with the removal of the rocker arm cover. Note from where components were removed.
- C. Remove the rocker arm cover bolts.
- D. Remove the rocker arm cover.

II. Dynamic Valve Train Analysis

Note: Repair and/or replace any deficiencies as required.

Start the engine and while running at idle check for proper operation of all parts. Check the following items while engine is running.

- A(1). Rocker Arm Assemblies (individually mounted).
 1. Check for plugged oil feed in rocker arm.
- A(2). Rocker Arm Shaft Assemblies
 1. Check for plugged oil feeds.
 2. Check for proper valve train lubrication.
 - a. If a condition of insufficient oiling is suspected, accelerate engine to 1200 ± 100 rpm with the transmission in neutral or park and the parking brake on, and engine at normal operating temperature. Oil should spurt from rocker arm oil holes such that valve

tips and rocker arms are well oiled and/or, with rocker arm cover off, oil splash may overshoot rocker arm. If oiling is insufficient for this condition to occur, check oil passages for blockage.

- B. Push Rods
 1. Check for bent push rods.
 2. Check for proper rotation of push rods.
- C. Positive Rotator and Keys (if so equipped)
 1. Check for proper operation of positive rotator.
- D. Valves and Cylinder Head
 1. Check for plugged oil drain back holes.
 2. Check for missing or damaged valve stem oil seals or guide mounted oil seals.

III. Static Valve Train Analysis

Note: Repair and/or replace any deficiencies as required.

Check for damaged and/or severely worn parts, for correct assembly and assure use of correct parts, then proceed as follows:

- A. Valves and Cylinder Head
 1. Check valve lash (mechanical tappet applications).
 2. Check collapsed tappet gap (hydraulic tappet applications).
 3. Check installed spring height.

- B(1). Rocker Arm Assemblies (individually mounted).
 - 1. Check for loose/cracked mounting stud and nut or bolt.
- B(2). Rocker Arm Shaft Assemblies
 - 1. Check for loose mounting bolt(s).
- C. Remove rocker arm shaft assemblies or rocker arm assemblies (as applicable).
 - 1. Check for plugged oil feeds.
- D. Push Rods
 - 1. Check for bent push rods by spinning push rods in place.
 - 2. Check tip wear pattern.
- E. Valve Spring Assembly (with or without damper spring)
 - 1. Check for damaged parts.
- F. Oil Deflector Shields (460 V-8 only)
 - 1. Check for cracks or deformities.
- G. Retainer and Keys (both 2 piece and 1 piece retainers)
 - 1. Check for proper seating of keys on valve stem and in retainer.
- H. Positive Rotator and Keys
 - 1. Check for proper seating of keys on valve stem and in positive rotator.
- I. Valve Tips and Oil Seals
 - 1. Check for worn or damaged valve tips.
 - 2. Check for missing or damaged valve stem oil seals or guide mounted oil seals.

IV. Reinstallation of Components

- A. Reinstall rocker arm shaft assemblies or rocker arm assemblies (as applicable). See caution for engines equipped with hydraulic tappets.

Caution: Any time the rocker arm or rocker arm shaft is loosened and/or removed, the instructions in the shop manual must be followed. Use applicable portion of instruction for one or more rocker arms. This is to prevent the bending of push rods or valves.

- 1. Start engine and check for proper lubrication.
- 2. Set valve lash (for engines equipped with solid tappets).

B. Rocker Cover

- 1. Remove old gasket or sealant material from cover.
- 2. Scrape both the rocker arm cover rail on the cylinder head and the gasket flange on the cover to remove all traces of the old gasket or sealant material if necessary.
- 3. Install a new gasket and replace the cover on the engine.
- 4. Reinstall the rocker arm cover bolts and tighten in accordance with applicable sequence and torque specification. Insure all brackets and clips are installed in correct location.
- 5. Reconnect all hoses, wires, spark plug leads and components that were removed in Part I.

SSD-18 CARBURETOR CLEANING

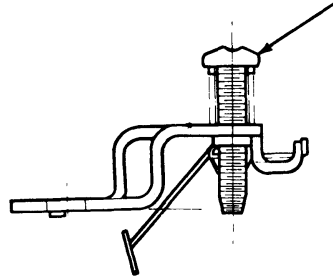
YFA 1V Carburetors

This procedure is to be used if contamination must be removed from the carburetor:

- Clean parts with lead free fuel or equivalent if engine is equipped with catalyst.
 - After cleaning the carburetor, flush the fuel system.
 - For carburetor disassembly and assembly refer to the service manual.
1. Remove carburetor from engine and:
 - a. Remove airhorn.
 - b. Clean fuel bowl. Remove and clean float, inlet needle and seat, inlet filter screen, and blow out inlet channels with compressed air.
 - c. Remove and clean idle jet and pump discharge weight and ball.
 - d. Remove and clean step-up spring, metering rod, main metering jet and pump diaphragm assembly. (Refer to Fig. 22.)
 - e. Using compressed air, dry all parts, blow out all channels, parts, and fuel bowl.
 - f. Reassemble carburetor in reverse order (Steps b, c, and d).
 - g. Adjust dry float setting to specification as listed in the Truck Performance Specifications Book, and reassemble air horn with new gasket.
 2. Reinstall carburetor on engine with new gasket.
 3. Install new fuel filter.

4. Check all idle speeds and idle fuel mixture. (Refer to the Vehicle Emission Control Information Decal and SSD-13, and SSD-26.) Adjust as required and install new limiter at maximum rich position.

NOTE:
DO NOT REMOVE, ADJUST,
OR TURN METERING ROD
ADJUSTING SCREW DURING
DISASSEMBLY OR ASSEMBLY
OF CARBURETOR.



V2151-1A

FIG. 22 Metering Rod Adjusting Screw

2150 Carburetor

This procedure is to be used if contamination must be removed from the carburetor:

- After cleaning the carburetor, flush the fuel system.

- For carburetor disassembly and assembly refer to the service manual.

1. Disassemble and clean carburetor in the following sequence:
 - a. Remove airhorn.
 - b. Note position on idle limiter caps.
 - c. Clean fuel bowl. Remove and clean float, inlet needle and seat, inlet filter screen.
2. If further cleaning is required, remove carburetor from engine and:
 - a. Clean fuel bowl. Remove and clean booster hold down screw, booster assembly, pump weight, pump check ball.
 - b. Remove and clean accelerator pump cover, pump spring, power valve cover, power valve, main metering jets.
3. Using compressed air dry all parts, blow out all channels in booster assembly (if applicable), main body and airhorn.
4. Reassemble carburetor in reverse order of steps one and/or two. Use new gaskets for the following as required.
Power Valve, Power Valve Cover, Booster Assembly and Accelerator Pump Diaphragm.
Caution: For safety purposes, temporarily secure airhorn to start engine. Remove for float level check.
5. Install new fuel filter.
6. If required, reinstall assembled carburetor to specifications (refer to Truck Performance Specifications Book) on engine using new gaskets.
7. Check fuel level to specifications (refer to Truck Performance Specifications Book), and adjust as required.
8. Reinstall airhorn to specifications with new gasket.
9. Check all idle speeds and idle fuel mixture to specifications (refer to the Vehicle Emission Control Information Decal and SSD-13 and SSD-26). Adjust as required.

Holley Carburetors 4150, 4180, 2300

This procedure is to be used if contamination must be removed from the carburetor:

- After cleaning the carburetor, flush the fuel system.

- For carburetor disassembly and assembly refer to the service manual.

1. Remove all external connections, fuel lines, throttle linkage, choke linkage, etc.
2. Remove the carburetor from the intake manifold and set it on a suitable carburetor stand or holding fixture.
3. Remove the lock screw from the external needle and seat assembly and remove the needle and seat assembly. The 4150 and 4180 have two needle and seat assemblies. The 2300 has one assembly.
4. Remove the float bowls, both primary and secondary.
5. Remove the metering blocks or plates from the main body.
6. Remove main metering jets and power valve assembly from the metering blocks.
7. Clean by thoroughly blowing out all metering block passages with compressed air.
8. Reinstall main metering jets and power valve (with new gasket) in metering blocks.
9. Blow out all passages in main body and throttle body with compressed air.
CAUTION: If carburetor is to be cleaned in a carburetor solution, all subassemblies have to be removed so as not to destroy rubber diaphragm and gaskets.
10. Install new needle and seat assemblies with new gaskets.

Notes:

- a. Apply a small amount of petroleum jelly to the inlet needle "O" ring for easy installation into the bowls.
 - b. For approximate fuel level setting, invert bowls and adjust fuel inlet needles so top of float is parallel with top of bowl.
11. Reinstall fuel bowls and metering blocks with all new gaskets and "O" rings. Be sure to lubricate "O" rings for ease of installation.
 12. Reinstall carburetor on engine and connect all fittings and linkage.
 13. Start engine and check for fuel leaks, and set fuel level to specs. (Refer Truck Performance Specifications Book.)

SSD-19 DECEL THROTTLE CONTROL SYSTEM

NOTE: For systems with delay valves, check the valves per SSD-2.

I. Preliminary Instructions

- A. Remove the air cleaner and plug any vacuum lines removed.
- B. For vehicle diagnostic, set the parking brake and block the wheels.
- C. Check the throttle and choke linkage for freedom of movement.
- D. Connect a Tachometer.

II. Vacuum Diaphragm Check

- A. Disconnect the vacuum line from the diaphragm. Connect an external vacuum source to the diaphragm, apply and trap 19" Hg.
If the diaphragm does not respond or will not hold vacuum, replace the diaphragm.
- B. Remove the external vacuum source. If the diaphragm does not return within 5 seconds, replace the diaphragm.
- C. Reconnect the vacuum line.

III . PVS Check (If Equipped)

- A. Disconnect the hose from the PVS to the solenoid vacuum valve at the valve and connect a vacuum gauge.
- B. Start the engine and let it idle long enough to reach normal operating temperature. At normal operating temperature, there should be a vacuum indicated on the gauge. If not, check the vacuum supply hose. If plugged or leaking, replace the hose. If not, replace the PVS.
- C. Remove the gauge and reconnect the vacuum line.

IV. Solenoid Vacuum Valve Check

- A. Start the engine and bring to normal operating temperature.
- B. Make sure that the choke plate is fully open. Engine at idle, transmission in neutral.
- C. Turn off air conditioner and/or power take-off, if equipped.
- D. Disconnect the vacuum supply hose at the solenoid valve and check for vacuum. If there is no vacuum, clean or replace as required. Reconnect the hose.

NOTE: If a vacuum delay valve is used, remove the valve and install a straight connector.

- E. Disconnect the wires to the solenoid valve. Using a jumper wire, apply battery voltage to one of the solenoid terminals. The engine speed should not increase; if it does, replace the valve.
- F. Using a second jumper wire, ground the other terminal of the valve. The engine speed should increase. If there is no increase, replace the valve.
- G. Remove the ground jumper wire. The engine should return to idle within 15 seconds. If not, replace the valve.
- H. Reconnect all system components.

V. Electronic Speed Sensor Module

- A. Check the harness connection at the module.
Note: For super duty only, by-pass the vacuum sensing switch by connecting a jumperwire across the harness connector terminals.
- B. Start the engine and run long enough to reach normal operating temperature.

- C. While watching the vacuum diaphragm assembly accelerate slowly, the diaphragm should extend above 1850 rpm (± 100) and retract below 1600 rpm. If not, perform the following checks with the engine not running, but the ignition ON.

NOTE: Number the harness terminals 1-6 or 8 starting from the key side of the connector.

If any of these are not to specification, repair the wiring as required.

If all readings are to specification, replace the module.

VI. Vacuum Sensing Switch (Super Duty Only)

- A. Disconnect the electrical harness connector to the switch.
- B. Connect a test light between one terminal of the connector and a battery voltage source. Ground the other terminal.
- C. Disconnect the vacuum hose at the switch.
- D. Apply an external vacuum source to the switch. The light should indicate as follows:

Vacuum in. Hg.	19.4 and Below	19.5-20.5	20.6 and Above
Test Light	OFF	OFF or ON	ON

CA4842-1A

- E. Any deviation from the above indicates a defective switch. Replace the switch.
- F. Remove the test equipment and reconnect the switch.

SYSTEM ADJUSTMENT

(To be performed if components are replaced)

- a) Insure engine is driving minimum load by:
 - 1) Setting transmission in neutral
- b) Adjust curb idle speed to:
 - 1) Specifications for manual transmission applications or
 - 2) One-hundred and fifty (150) rpm above specified "in drive" idle rpm for automatic transmission applications.

(Refer to the Vehicle Emission Control Information Decal for curb idle speed specifications.)

HARNESS CONNECTOR CHECK

Without Electronic Governor

Terminal No.	Condition	Meter	Value
1 — Ground	Key ON	Volt	12V
4 — Ground	Key ON	Volt	12V
6 — Ground	Key ON	Volt	12V
1 — 3	Key OFF	Ohm	Continuity
1 — 5	Key OFF	Ohm	Continuity

With Electronic Governor

1 — 2	Engine Running	Tach.	RPM
1 — 8	Key ON	Volt	12V
4 — 6	Key OFF	Ohm	Continuity
5 — 7	Key OFF	Ohm	Continuity

CA4841-2A

- c) Disconnect system vacuum hose to the throttle positioner diaphragm and plug. Connect engine manifold vacuum source to diaphragm with a "slave" vacuum hose.
- d) Allow one (1) minute for engine speed to stabilize.
 - 1) If engine speed is within specified rpm limits for that engine application (refer to the Vehicle Emission Control Information Decal), the positioner is properly set. Go to Step (g).
 - 2) If engine rpm is not within specified rpm limits for that engine application, adjust the positioner by loosening the lock nut on the throttle positioner and turning the positioner (or screw on Holley carbs.) in or out to obtain the proper speed. For adjustment on Carter IV—to avoid damage to the vacuum diaphragm, hold diaphragm shaft with a 1/4 inch open end wrench, and rotate adjustment screw in or out using a 3/8 inch open end wrench. Retighten the lock nut, if so equipped. On units without a lock nut Locktite 290 might have been applied to the threads of the positioner adjusting screw during manufacturing to prevent the screw from backing out due to vibration. DO NOT attempt to turn the screw without first heating the immediate area enough to loosen the Locktite. Heat the area with an electric soldering gun while applying torque to the screw until the Locktite softens and the screw can be easily turned.
- e) Disconnect manifold vacuum hose from the positioner diaphragm and allow the engine to return to curb idle conditions.
- f) Repeat Steps (b) through (e), as required.
- g) Disconnect manifold vacuum hose from the positioner diaphragm, and allow the engine to return to the idle conditions. Remove plug from and reconnect system vacuum hose to the diaphragm.
- h) **For automatic transmission applications only**—set "in drive" idle speed to specifications following the Maintenance Procedure D-3.
 - i) Stop engine. Install air cleaner, tighten air cleaner nut to specification.
 - j) Disconnect tachometer.

SSD-22 EVAPORATIVE EMISSION CONTROL SYSTEM

A. Engine will Not Run or Start

1. Remove the purge line from the PCV line "Tee" and "Cap". Attempt to start the engine.
2. If the engine now runs, proceed to the next step; if not, continue with the Diagnostic Routine pertaining to the overt vehicle problem.
3. With the engine running at idle, disconnect the vacuum signal hose from the purge valve, disconnect canister hose from the purge valve, remove the valve from the evaporative canister and reconnect the purge line to the PCV line "Toe". If a strong hissing sound is heard from the purge valve, replace it. **Note: A slight hissing sound may be heard due to the small valve orifice.**
4. Connect a vacuum gage to the vacuum signal hose to the purge valve. Bring the engine to normal operating temperature. With the transmission selector in neutral, run the engine at approximately 2000 RPM for 10-20 seconds. The vacuum gage reading should be at least 5" Hg. minimum. If not, check the carburetor signal port for any blockage per Reference Two, Step # 25, the ported signal PVS per SSD-1, the PCV per SSD-11 or the SDV, two way delay valve, and/or RDV per SSD-2. Repair and/or replace as required.
5. With the canister hose still removed from the purge valve, connect a vacuum source to the purge valve and apply 5" Hg vacuum. With the engine idling, listen for a strong hissing. If a strong hissing is not heard, replace the valve.
6. Disconnect the vacuum source from the purge valve and reconnect the vacuum signal hose. With the engine at idle, there should not be any strong hissing. If there is, check the SDV, two way delay valve, and/or RDV per SSD-2 and the

ported signal per Reference Two, Step # 25. Repair and/or replace as required.

7. Reconnect all parts and hoses as originally equipped.

NOTE: Be sure that the carburetor bowl vent line has a continuous downward slope to the evaporative canister.

B. Engine Will Start and Run

1. Start the engine and with it running at idle, disconnect the vacuum signal hose from the purge valve and remove the canister hose from the purge valve. If a strong hissing sound is heard from the purge valve, replace it. **Note: A slight hissing sound may be heard due to the small valve orifice.**
2. Connect a vacuum gage to the vacuum signal hose to the purge valve. Bring the engine to normal operating temperature. With the transmission selector in neutral, run the engine at approximately 2000 RPM for 10-20 seconds. The vacuum gage reading should be at least 5" Hg. minimum. If not, check the carburetor signal port for any blockage per Reference Two, Step # 25, the ported signal PVS per SSD-1, the PCV per SSD-11 or the SDV, two-way delay valve, and/or RDV per SSD-2. Repair and/or replace as required.
3. With the canister hose still removed from the purge valve, connect a vacuum source to the purge valve and apply 5" Hg. vacuum. With the engine idling, listen for a strong hissing. If a strong hissing is not heard, replace the valve.
4. Disconnect the vacuum source from the purge valve and reconnect the vacuum signal hose. With the engine at idle, there should not be any strong hissing. If there is, check the SDV and/or

RDV per SSD-2 and the ported signal per Reference Two, Step #25. Repair and/or replace as required.

5. Reconnect all parts and hoses as originally equipped.

NOTE: Be sure that the carburetor bowl vent line has a continuous downward slope to the evaporative canister.

SSD-26 ENGINE IDLE SPEEDS

Refer to Maintenance Manual Procedure Part 50-29, D-2 (SSD-26) for Engine Idle Speed Adjustment Procedure.

SPECIFICATIONS

EMISSION CONTROL SYSTEM DIAGNOSIS AND SERVICE PROCEDURES

For specifications not contained in this Part refer to the Vehicle Emission Control Information Decal, and the appropriate "Service" or "Performance Specifications"

Book for the truck being serviced. Also refer to the respective Shop Manual part for the individual components or systems being diagnosed or serviced.

For Emission Control System component location and hose routings refer to the "Engine and Emission Systems Manual."

Thermactor System

**PART
29-03**

SUBJECT	PAGE	SUBJECT	PAGE
DESCRIPTION AND OPERATION	29-03-1	MAINTENANCE	
Air By-Pass Valve	29-03-2	Air Pump Assembly	29-03-4
Air Pump	29-03-1	Centrifugal Filter Fan	
Exhaust Check Valve	29-03-3	Replacement	29-03-5
Idle Vacuum Valve	29-03-3	Air Pump Drive Belt Tension	29-03-5
Thermactor Idle Dump	29-03-3		
DIAGNOSIS AND TESTING	29-03-4		

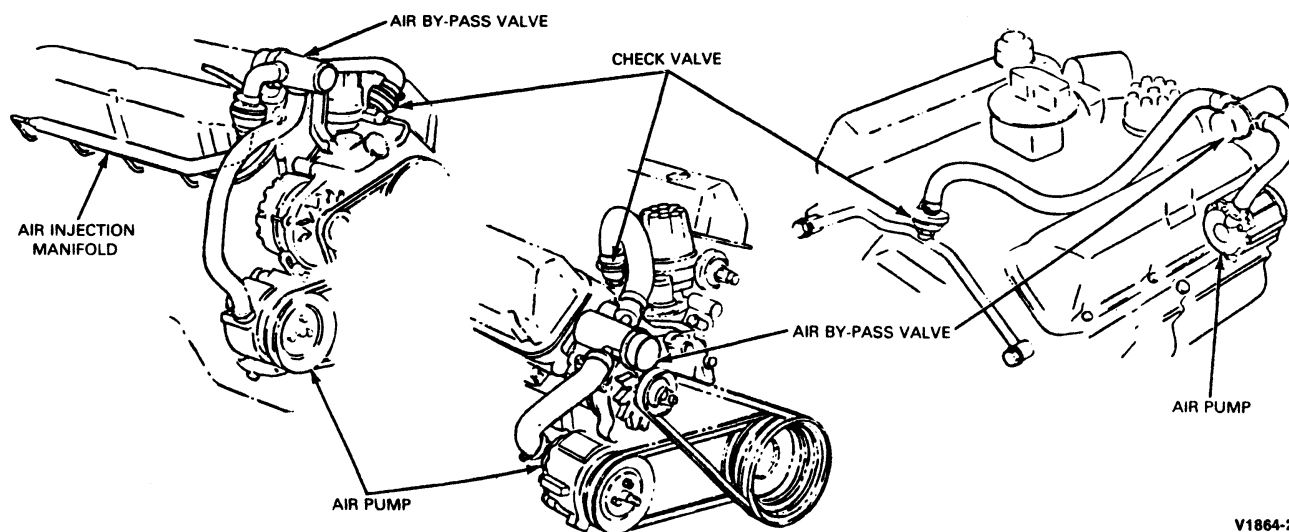
DESCRIPTION AND OPERATION

A "Thermactor" air injection system is installed on various engines intended for sale in California and the other 49 states. The Thermactor Exhaust Emission Control System (Fig. 1) reduces carbon monoxide and hydrocarbon content of combustion by-product gases, by injecting fresh air into the hot exhaust gas stream as it leaves the combustion chamber. A pump supplies air under pressure to the exhaust port near the exhaust valve, by either an "external" air manifold, or through "internal" drilled-passages in the cylinder head or exhaust manifold. The oxygen in the fresh air, plus the heat of the exhaust gases, causes further oxidation

(burning), which converts the exhaust gases into carbon dioxide and water vapor.

The major components of a typical Thermactor system include:

- Air supply pump (Fig. 3)
- External air injection manifold, (Fig. 7) or
- Cylinder head/exhaust manifold with internal air passages
- Air by-pass valve (Figs. 4, 5 and 6)
- Idle vacuum valve (Figs. 8 and 9)
- Check valve (Fig. 1)
- Hoses, clamps and brackets



V1864-2B

FIG. 1 Typical Thermactor Systems

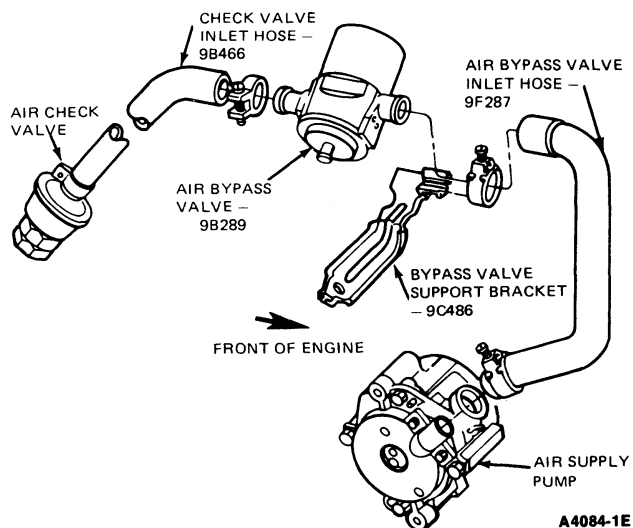


FIG. 2 Typical Thermactor System Components

AIR PUMP

The belt driven air pump (Fig. 3) takes air in through an impeller-type positive-displacement centrifugal air filter fan, thus eliminating the need for a separate air filter. Dust and dirt particles cannot enter the pump because these heavier than air contaminants are thrown from the air intake by centrifugal force.

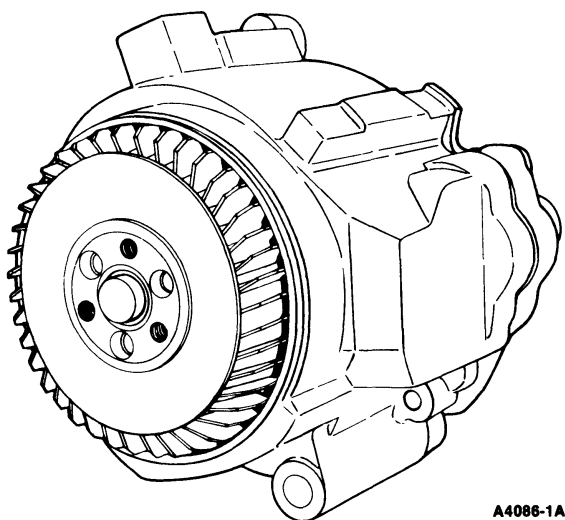


FIG. 3 Air Supply Pump

AIR BY-PASS VALVE

There are three different types of by-pass valves.

1. Timed By-Pass Function: (Normally Open)

The air by-pass valve (Fig. 4) prevents "backfiring" during engine deceleration when larger amounts of unburned gases flow into the exhaust manifold which can cause rapid burning when fed fresh air. To prevent this possible backfire condition, the by-pass valve momentarily diverts air from the pump to the atmosphere, preventing the mixing of fresh air with the unburned gases in the exhaust manifold.

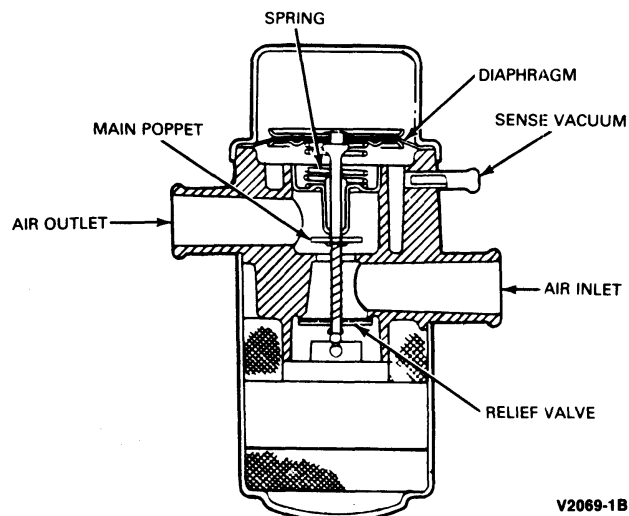


FIG. 4 Typical Air By-Pass Valve—Timed By-Pass Function

During normal operation (Fig. 4), vacuum is equalized on both sides of the diaphragm. The return spring holds the valve open, thus allowing fresh air to flow to the air outlet.

During deceleration, however, the sudden rise of intake manifold vacuum under the diaphragm overcomes spring pressure and pulls the valve downward (Fig. 4). Air is then diverted to the atmosphere momentarily, and as vacuum is quickly equalized again on both sides of the diaphragm through a small orifice in the diaphragm, the valve returns to its original position. The valve also performs or relief function for air pump protection against high back pressure.

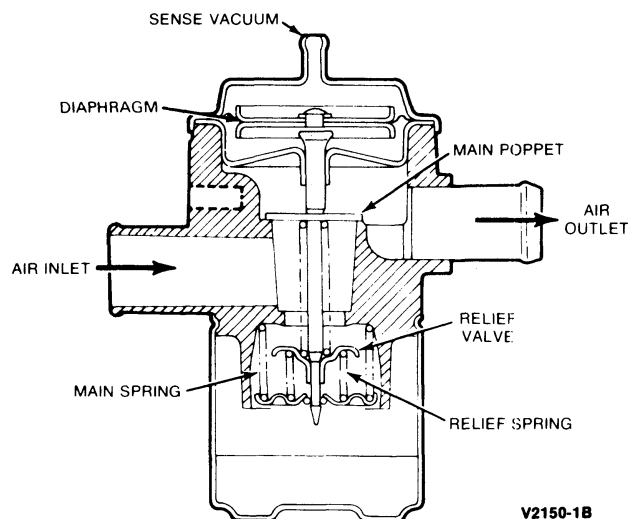


FIG. 5 Normally Closed Air By-Pass Valve—Remote Mounted

2. Normally Closed:

When no vacuum signal is applied to the by-pass valve (Figs. 5 and 7) diaphragm, all of the air from the pump is diverted and dumped to the

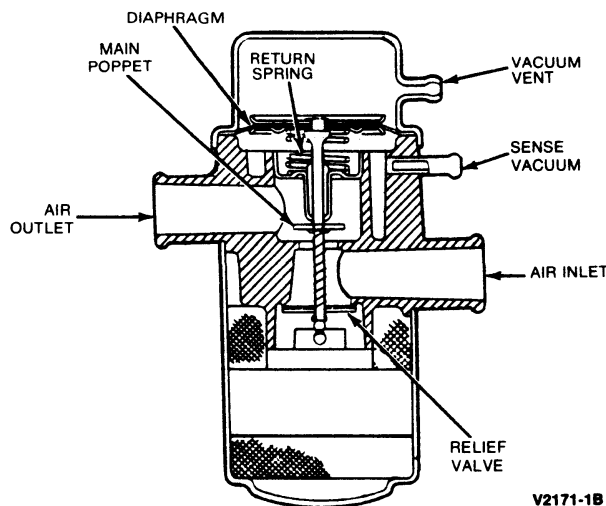


FIG. 6 Timed Air By-Pass Valve with Vacuum Vent—Remote Mounted

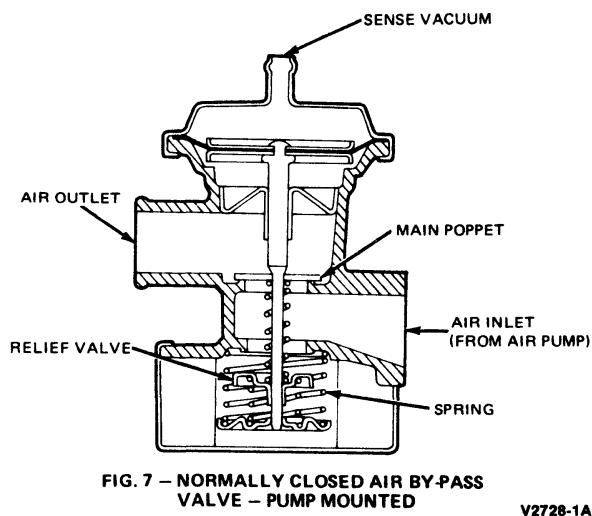


FIG. 7 Normally Closed Air By-Pass Valve—Pump Mounted

atmosphere for catalytic converter protection (the valve is normally closed). When a vacuum signal (as calibrated) is applied to the by-pass valve diaphragm, all of the air is directed to the engine. The valve also performs a relief function to protect the air pump in the event an excessive downstream restriction occurs (Fig. 5).

3. Timed and Vented:

Functions as a "timed" valve until vented, (auxillary control), will continuously by-pass as long as signal vacuum is eight in. Hg. or more (Figs. 6 and 8), and vacuum is vented to the atmosphere. The same relief function is performed by the valve as in Fig. 4.

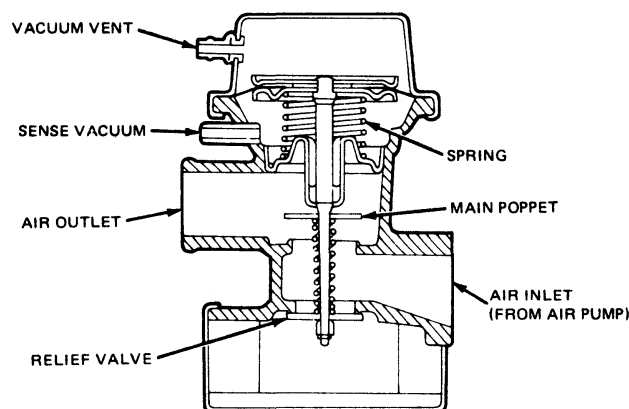


FIG. 8 Timed Air By-Pass Valve With Vacuum Vent—Pump Mounted

FIG. 8 Timed Air By-Pass Valve With Vacuum Vent—Pump Mounted

THERMACTOR IDLE "DUMP"

Air from the Thermactor pump is directed past open relief valve and is "dumped" to atmosphere through vent openings. This condition exists during idle periods of approximately 1/2 to 1 minute or more.

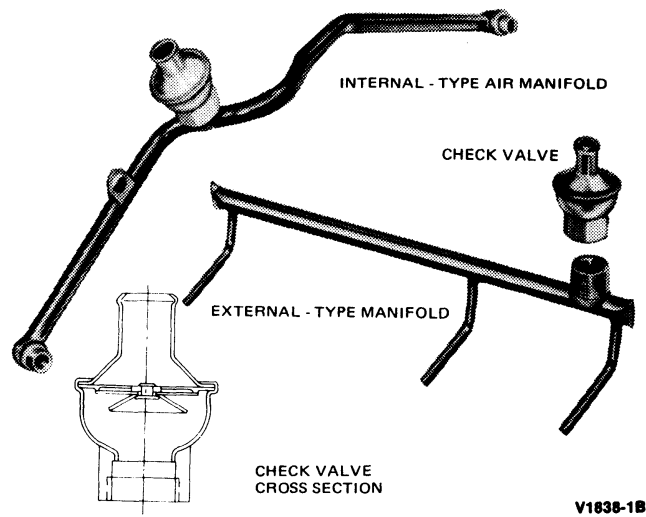
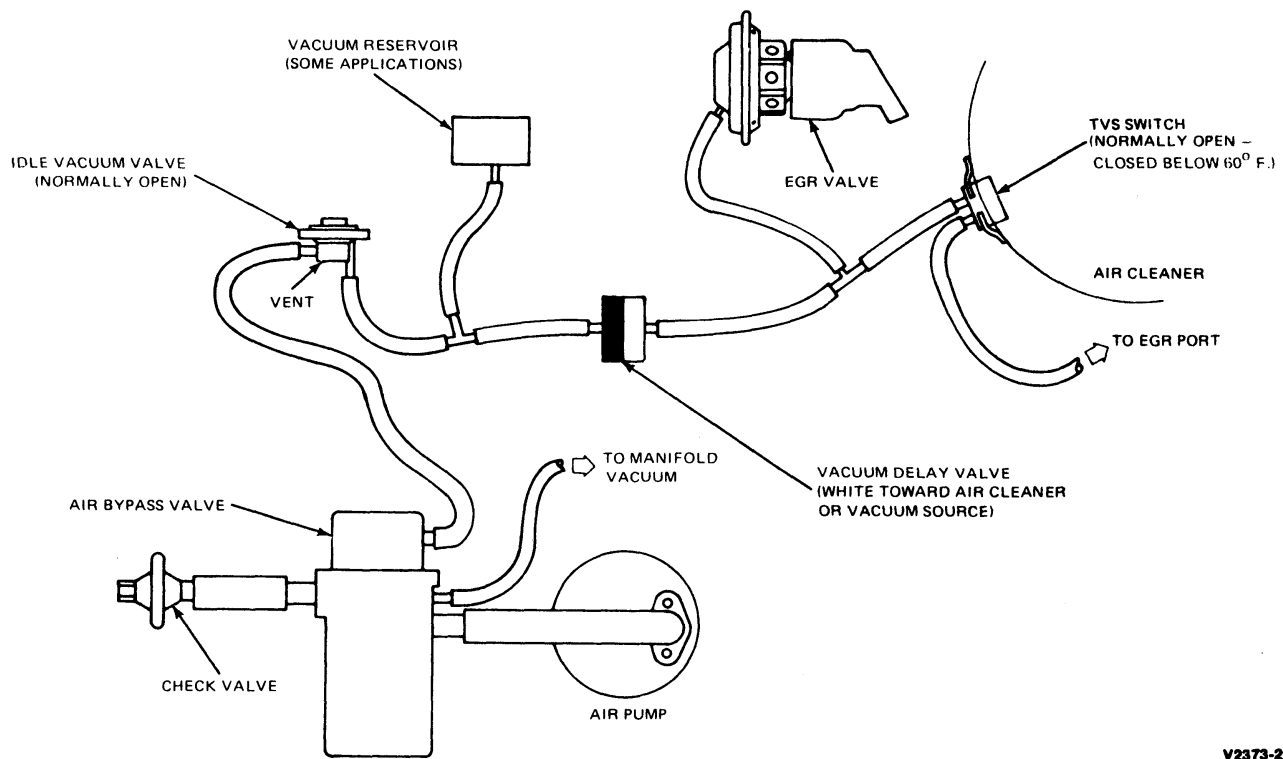
EXHAUST CHECK VALVE

The exhaust gas check valve (Fig. 9) allows fresh air to flow into the exhaust port, but prevents the reverse flow of exhaust gases, in the event of improper operation of air pump or low pressure. The valve is located on the air manifold for "external" systems, or the air crossover manifold for engines using "internal" systems (drilled cylinder heads).

IDLE VACUUM VALVE

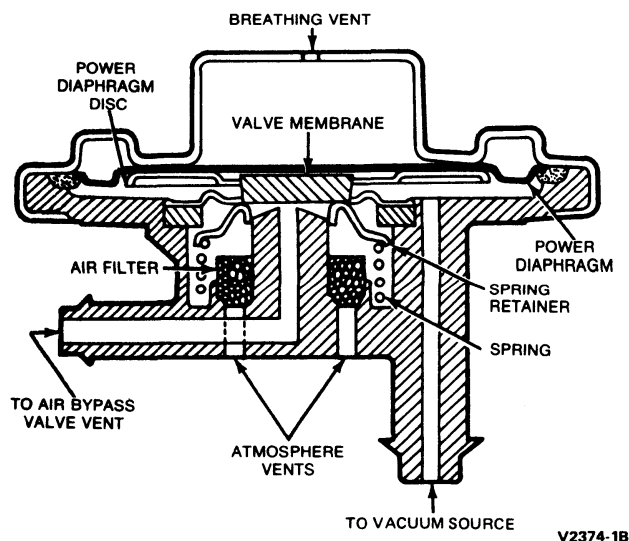
The idle vacuum valve, operating in conjunction with a vacuum delay valve, provides backfire control, full-time idle air dump, cold temperature catalyst protection and cold EGR lockout (Fig. 10). The idle air dump of secondary air pump output during extended engine idle periods (approximately 1/2 to 1 minute or more) helps prevent excessive underbody temperatures caused by the exhaust system.

A ported vacuum signal from the carburetor moves the power diaphragm, which in turn, closes or opens vents to the atmosphere by moving the valve membrane (Fig. 11). Vacuum from the EGR port is used to switch off the thermactor at idle because no vacuum is present at closed throttle conditions. The idle vacuum valve is open (vented) to atmosphere to dump thermactor air during cold engine operation, extended idle periods (1/2 to 1 minute, or more) and deceleration. During warm engine or normal operation, the vacuum valve is closed to atmosphere to allow passage of thermactor air.

**FIG. 9 Check Valve and Air Manifolds**

V2373-2A

FIG. 10 Thermactor Idle Valve with Vacuum Delay Valve (Typical)



V2374-1B

FIG. 11 Idle Vacuum Valve

DIAGNOSIS AND TESTING

Refer to SSD-4 and/or SSD-5, Part 29-02.

MAINTENANCE

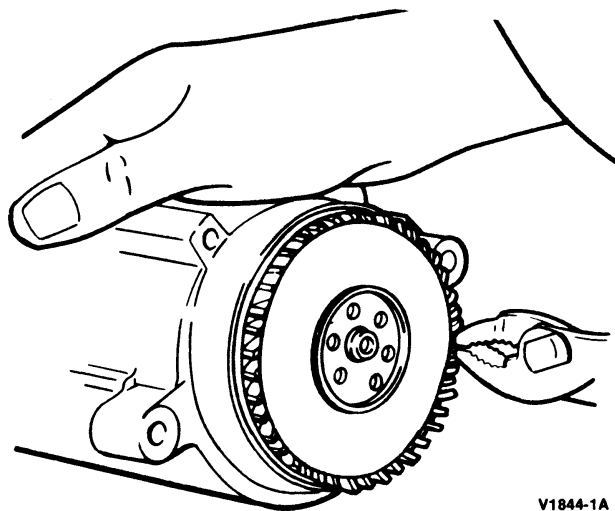
AIR PUMP ASSEMBLY

The air pump bearings are sealed and permanently lubricated. The rotor vanes and bearing clearances are established during initial assembly. Therefore, lubrication, adjustment or overhaul are not required.

- a. Replace air pump if it fails air pump test or becomes noisy (refer to Part 29-02).
- b. Replace centrifugal filter fan if it is damaged.

CENTRIFUGAL FILTER FAN REPLACEMENT

1. Loosen the air pump adjusting arm bolt and mounting bracket bolt to relieve drive belt tension.
2. Remove drive pulley attaching bolts and pull drive pulley off the air pump shaft.
3. Pry the outer disc loose; then, pull off the centrifugal filter fan with slip-joint pliers (Fig. 12).
4. **Do not attempt to remove the metal drive hub.**
5. Install a new filter fan by drawing it into position, using the pulley and bolts as an installer. Draw the fan evenly by alternately tightening the bolts, making certain that the outer edge of the fan slips into the housing. Tighten the pulley bolts to specifications, indicated at the end of the applicable engine Part in this manual.
6. **A slight interference with the housing bore is normal. After a new fan is installed, it may**



V1844-1A

FIG. 12 Removing Centrifugal Filter Fan

squeal upon initial operation, until its outer diameter sealing lip has worn in, which may require 20-30 miles of operation.

AIR PUMP DRIVE BELT TENSION ADJUSTMENT

Refer to SSD-4 or SSD-5, Part 29-02.

Exhaust Gas Recirculation System

PART
29-07

SUBJECT	PAGE	SUBJECT	PAGE
DESCRIPTION AND OPERATION	29-07-1	DIAGNOSIS AND TESTING	
EGR Valve	29-07-1	Cleaning	29-07-2
Integral Transducer —		Inspection — EGR Valve	29-07-2
EGR System	29-07-2		
Venturi Vacuum Amplifier	29-07-2		

DESCRIPTION AND OPERATION

The Exhaust Gas Recirculation System (EGR) is designed to re-introduce small amounts of exhaust gas into the combustion cycle, thus reducing the generation of nitrous oxides (NOX). The amount of exhaust gas re-introduced and the timing of the cycle are controlled by various factors such as engine vacuum and temperature. A typical system is shown in Fig. 1.

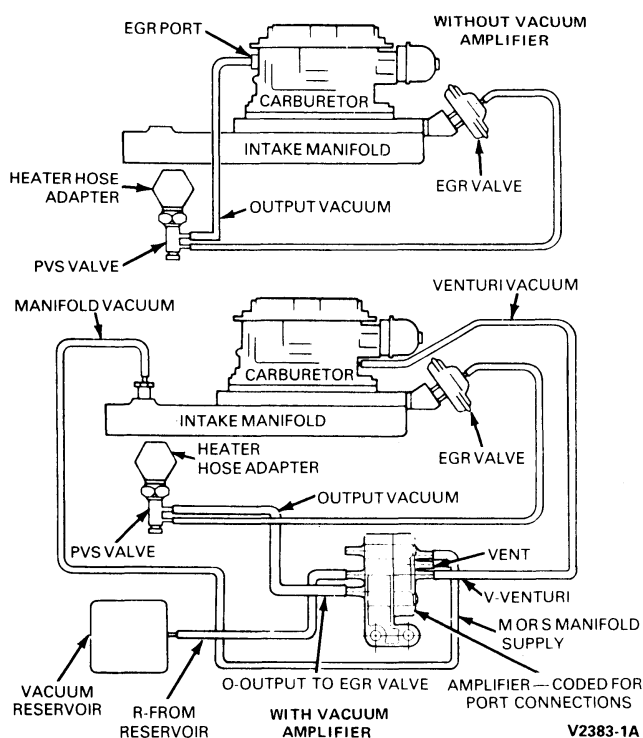


FIG. 1 EGR System Components

EGR VALVE

The EGR valve (Fig. 2) is a vacuum-operated unit that attaches to a spacer mounted between the carburetor

and intake manifold (Fig. 3). When the valve is open, exhaust gas is permitted to enter the intake manifold passages. When the valve is closed it prevents the flow of exhaust gases into the intake passages.

VENTURI VACUUM AMPLIFIER

The EGR venturi vacuum amplifier uses a relatively weak venturi vacuum signal in the throat of the carburetor to shape a strong intake manifold vacuum signal to operate the EGR valve. This makes it possible to achieve an accurate, repeatable and almost exact proportion between venturi air flow and EGR flow. Thus, it assists in controlling oxides of nitrogen emissions with minimal sacrifice in vehicle driveability.

The amplifier may have an exterior vacuum reservoir and check valve to maintain adequate vacuum supply regardless of variations in engine manifold vacuum.

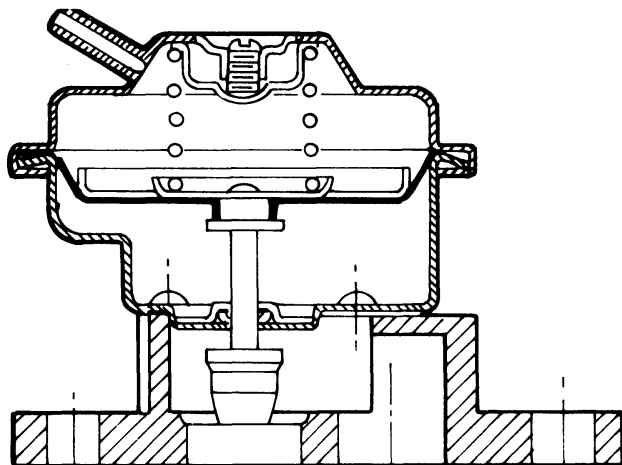
A relief valve is also used to "dump" or cancel the output EGR signal when the intake manifold vacuum is low. This allows the EGR valve to close at or near wide-open throttle acceleration, when maximum power is required from the engine.

For some engine applications, the amplifier is calibrated with a output bias. In other words, when the venturi vacuum signal is at zero, the output signal already has a pre-determined output (approximately 1-2 in. Hg.). This feature permits a rapid system response in overcoming the EGR valve spring closing force.

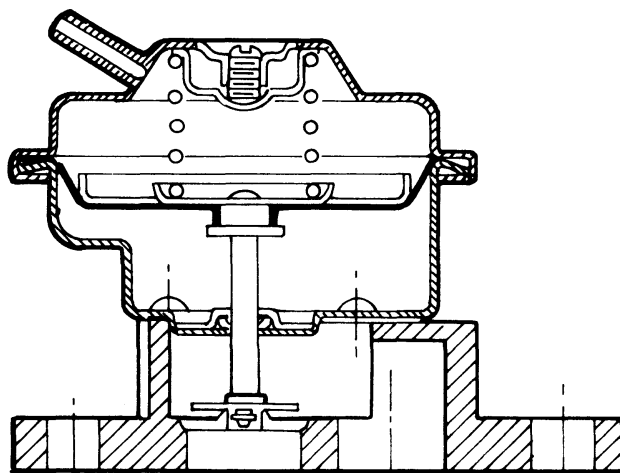
INTEGRAL TRANSDUCER-EGR SYSTEM

This valve performs the same function as the separate back pressure transducer and EGR valves used on some systems. The valve assembly (Fig. 4) has an internal exhaust gas chamber with a transducer diaphragm which senses exhaust backpressure through a hollow valve stem. When backpressure is low, vacuum is bled through the transducer bleed hole and the EGR valve stays closed. When the backpressure increases, the transducer diaphragm moves up and closes the

transducer valve vacuum bleed hole. With the vacuum bleed closed, the EGR valve opens, allowing exhaust gas to flow into the intake manifold. Because the EGR outlet passage is always exposed to manifold vacuum and EGR gas inlet flow is restricted by an orifice, backpressure at the transducer drops when the EGR valve opens. When the backpressure drops, the vacuum bleed hole opens, closing the EGR valve and allowing pressure to build up again. The cycle is continually repeated, modulating the flow of exhaust gas into the intake manifold.



TAPERED STEM



STRAIGHT STEM

V2371-1A

FIG. 2 EGR Valve Comparison

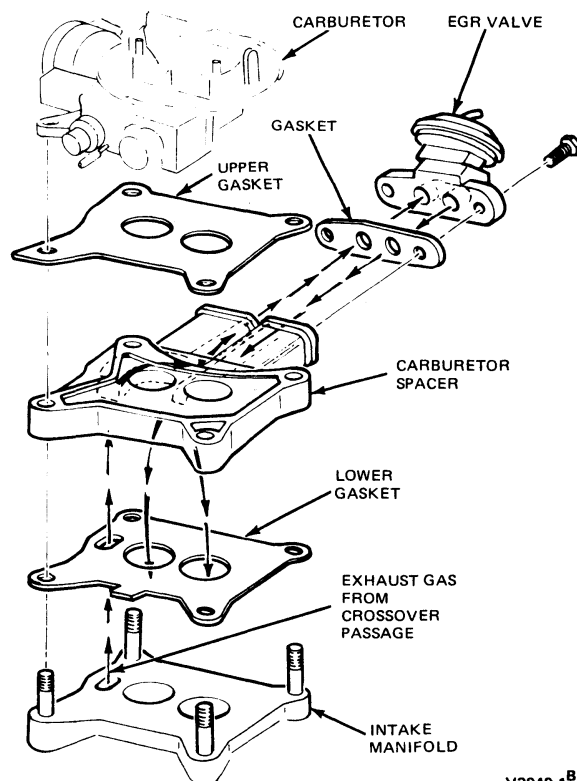
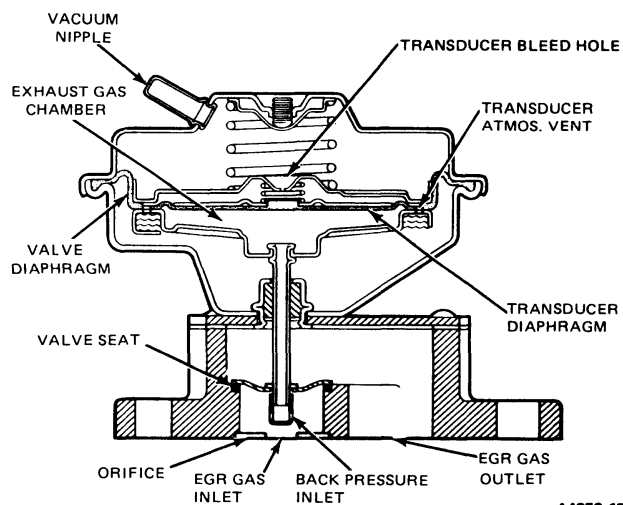
V2040-1^B

FIG. 3 Spacer Entry EGR System



A4259-1B

FIG. 4 Integral Transducer Back Pressure EGR Valve

DIAGNOSIS TESTING

CLEANING

Refer to SSD-1 of Part 29-02.

INSPECTION

EGR VALVE

Do not strike or pry on the valve diaphragm housing or supports, as this may damage the valve

operating mechanism and/or change the valve calibration.

Test the EGR valve as described in SSD-1 of Part 29-02. If required, remove and install the EGR valve as shown in Fig. 3.

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